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FEASIBILITY STUDY REPORT SITE 38 RUM POINT LANDFILL NSWC INDIAN HEAD MD
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TETRA TECH

Feasibility Study Report

Site 38 – Rum Point Landfill

Naval Support Facility Indian Head

Indian Head, Maryland

Naval Facilities Engineering Command
Washington

Contract Number N62470-08-D-1001

Contract Task Order JU03

June 2013

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FEASIBILITY STUDY REPORT
SITE 38 – RUM POINT LANDFILL

NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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1314 Harwood Street, SE
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ACRONYMS

AOC	Area of Contamination
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chemical of concern
COMAR	Code of Maryland Regulations
CSM	Conceptual Site Model
CTO	Contract Task Order
DoD	Department of Defense
EPA	United States Environmental Protection Agency
FS	Feasibility Study
GHG	greenhouse gas
GIS	Geographic Information System
GRA	general response action
HASP	Health and Safety Plan
HI	hazard index
IAS	Initial Assessment Study
ILCR	incremental lifetime cancer risk
LUC	land use control
mg/kg	milligrams per kilogram
MD	Munitions Debris
MDE	Maryland Department of the Environment
MEC	munitions and explosives of concern
MPPEH	Material Potentially Presenting an Explosive Hazard
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NSF-IH	Naval Support Facility Indian Head
O&M	operation and maintenance
ORP	oxidation reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PPE	personal protective equipment

PRG	preliminary remediation goal
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RFI	RCRA Facility Investigation
ROD	Record of Decision
RSL	risk-based screening level
SDWA	Safe Drinking Water Act
SSP	Site Screening Process
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBC	To be considered
TCL	Target Compound List
Tetra Tech	Tetra Tech, Inc.
µg/kg	micrograms per kilogram
µg/l	microgram per liter
USFWS	US Fish and Wildlife Service
UXO	Unexploded ordnance
VI	Verification Investigation
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This Feasibility Study (FS) Report for Naval Support Facility Indian Head (NSF-IH), Maryland, was prepared by Tetra Tech, Inc. (Tetra Tech) in response to Contract Task Order (CTO) JU03 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62470-08-D-1001. NSF-IH is a Naval Support Activity, South Potomac facility within the Naval District Washington Region. The purpose of this FS Report is to develop and evaluate potential remedial alternatives for mitigating environmental contamination at Site 38 – Rum Point Landfill. Environmental studies of this site began in 2002. A Site Screening Process (SSP) Report prepared in May 2008 (Tetra Tech, 2008) presented environmental data from the site and evaluated the data to estimate the human health and environmental risks resulting from on-site contamination.

Site 38 covers approximately 0.85 acres in the eastern portion of the Stump Neck Annex west of Rum Point Road. The landfill was originally intended for disposal of biodegradable waste and has been inactive since December 1989. The date when waste disposal began is not known, and little is known about the site history. Ash from a thermal treatment tank may have been disposed at the site on a one-time basis.

Wastes observed during previous site visits included scrap metal, tires, wood, and concrete construction debris. Contaminants present in the waste would have been deposited in the immediate area of disposal and could have migrated to shallow groundwater and intermittent streams that border the site. The surface of the site is mostly covered with grasses, with some trees present. The area surrounding the landfill is wooded, and trees have grown on the landfill slopes. Site observations indicate that the landfill was probably layered, with soil pushed south to north toward the toe of the landfill.

This FS develops remedial alternatives that address risks from exposure to contaminants at the site. There are no unacceptable risks to human health and the environment from exposure to surface water or sediment. There are unacceptable risks associated with exposure to site groundwater and inherent risks and safety concerns from exposure to landfill waste.

Alternative 1, the no action alternative, is included to serve as a baseline against which other alternatives are compared. Five-year reviews are required with this alternative because waste and contaminants would be left in place at concentrations exceeding those suitable for unlimited use and unrestricted exposure.

Alternative 2 would include the construction of an engineered cap over the landfill. The landfill would be cleared of all vegetation, filled and graded to an acceptable slope, capped, and revegetated. The engineered cap would consist of several layers, including (from the bottom to top) a gas management layer, low-permeability layer, drainage layer, final earthen cover, and vegetative stabilization.

Alternative 2 would also include land use controls (LUCs), monitoring, and five-year reviews. LUCs would include land and groundwater use restrictions to prevent unauthorized excavation, residential development, and use of shallow groundwater. Monitoring would be conducted to confirm that contaminants in groundwater are not migrating from the site at unacceptable levels. Five-year reviews are required because waste and contaminants would be left in place at concentrations exceeding those suitable for unlimited use and unrestricted exposure.

Alternative 3 includes removal of the entire landfill. The excavated material would be dewatered, as necessary, screened for potential ordnance items, and transported off site for disposal. The excavated area would not be backfilled. LUCs, monitoring, and five-year reviews would also be required. LUCs would include groundwater use restrictions to prevent unauthorized use of shallow groundwater. Monitoring would be conducted to confirm that contaminants in groundwater are attenuating and not migrating from the site at unacceptable levels. Five-year reviews are required because groundwater contaminants would be left in place at concentrations exceeding those suitable for unlimited use and unrestricted exposure.

Table ES-1 summarizes the evaluation of remedial alternatives and presents the costs for each alternative considered. The remedial alternatives were developed and evaluated in accordance with the nine criteria required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), in addition to sustainable remediation criteria.

TABLE ES-1

SUMMARY OF ANALYSIS OF ALTERNATIVES
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Engineered Cap and Land Use Controls	Alternative 3 – Landfill Removal, Monitoring and Land Use Controls
Threshold Criteria			
Overall Protection of Human Health and the Environment	No reduction in potential risks.	Engineered cap and LUCs would reduce risks to human health and the environment.	Landfill removal and LUCs would reduce risks to human health and the environment. Natural attenuation of groundwater contaminants would reduce risks to hypothetical future site residents.
Compliance with ARARs			
Chemical-specific	Not applicable.	Could be designed to attain ARARs that apply.	Could be designed to attain ARARs that apply.
Location-specific	Not applicable.	Could be designed to attain ARARs that apply.	Could be designed to attain ARARs that apply.
Action-specific	Not applicable.	Could be designed to attain ARARs that apply.	Could be designed to attain ARARs that apply.
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	Would allow uncontrolled risks to remain.	Engineered cap and LUCs would reduce risks to human health. Monitoring and use restrictions would provide adequate and reliable controls.	Landfill removal and LUCs would eliminate risks to human health. Monitoring and use restrictions would provide adequate and reliable controls.
Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment.	No treatment.	No treatment.
Short-Term Effectiveness	Not applicable. No short-term impacts or concerns.	No impacts to community. Exposure of workers to contaminated media could be adequately controlled. Existing habitat would be destroyed until cap is revegetated; could not be planted with existing types of vegetation that could damage impermeable layer. It is expected that the RAO could be achieved within a two month construction duration.	Hauling wastes off site would generate additional traffic. Exposure of workers to contaminated media could be adequately controlled. Existing terrestrial habitat would be destroyed and would revert to open water or converted to wetland. It is expected that the RAO could be achieved within the construction duration of two months.
Implementability	Nothing to implement.	Alternative consists of common remediation methods that are readily available and implementable. LUCs could be strictly enforced because site is located at military facility.	Alternative consists of common remediation methods that are readily available. There are implementability concerns associated with screening excavated materials for MEC. LUCs could be strictly enforced because site is located at military facility.
Cost			
Capital	$0	$ 1,129,000	$ 1,672,000
O&M		$ 18,000 per year plus $ 25,300 every 5 years	$ 19,600 per year plus $25,300 every 5 years
Present Worth		$ 1,641,000	$ 1,987,000
Modifying Criteria			
State Acceptance	Not applicable.	To be determined.	To be determined
Community Acceptance	Not applicable.	To be determined.	To be determined.
Sustainability	Not applicable.	Greatest environmental impact in terms of greenhouse gas emissions, energy use, water use, and some criteria pollutants. This impact is driven by the materials needed to construct the cap.	Equipment use for removing the landfill drives greenhouse gas emissions and energy use up. This alternative has a similar, but lesser, environmental impact when compared to Alternative 2.

ARARs Applicable or relevant and appropriate requirements.
MEC Munitions and explosives of concern.
RAO Remedial action objective
LUCs Land use controls.
O&M Operation and maintenance.

1.0 INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF REPORT

This Feasibility Study (FS) Report has been prepared for Naval Facilities Engineering Command (NAVFAC) Washington by Tetra Tech, Inc., in response to Contract Task Order (CTO) JU03 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62470-08-D-1001. The purpose of this FS was to develop and evaluate potential remedial alternatives to mitigate environmental contamination at Site 38 – Rum Point Landfill at Naval Support Facility Indian Head (NSF-IH), Maryland. NSF-IH is part of Naval Support Activity, South Potomac within the Naval District Washington Region. The FS Report summarizes information presented in the Site Screening Process (SSP) Report (Tetra Tech, 2008) and discusses the basis for remedial action that may be required at Site 38. In this report, remedial technologies and process options are evaluated and screened to select those that are most viable for site conditions and contaminants. The technologies and process options that pass the screening are combined to form remedial alternatives to address site contamination. The remedial alternatives are also evaluated to distinguish positive and negative aspects of each alternative.

Section 1.0 summarizes background information, physical characteristics of the site, previous investigations, and the results of the human health and ecological risk screening evaluations from the SSP Report and provides the Conceptual Site Model (CSM). Section 2.0 presents the objectives and goals of remediation, including preliminary remediation goals (PRGs), chemicals of concern (COCs), and media of concern. Section 3.0 presents the identification and screening of technologies and process options, Section 4.0 presents the development and screening of alternatives, and Section 5.0 presents the detailed analysis of alternatives. Section 6.0 presents the comparative analysis of alternatives.

1.2 FACILITY BACKGROUND

NSF-IH is located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, D.C (Figure 1-1). NSF-IH is a military facility consisting of the Main Area on the Cornwallis Neck Peninsula and the Annex on Stump Neck. As shown on Figure 1-2, the Main Area is bounded by the Potomac River on the northwest, west, and south, Mattawoman Creek to the south and east, and the Town of Indian Head to the northeast. Stump Neck Annex is located across Mattawoman Creek and is not contiguous with the Main Area. The location of Site 38 is shown on Figure 1-2.

1.3 SITE 38 BACKGROUND

1.3.1 Site Location and Description

Site 38 – Rum Point Landfill is located in the eastern portion of Stump Neck Annex west of Rum Point Road (Figure 1-3). The landfill was intended for disposal of biodegradable waste and has been inactive since December 1989. The date when waste disposal began is not known, and little is known about the site history. Ash from a thermal treatment tank may have been disposed of at the site on a one-time basis. Wastes observed on the landfill surface during previous site visits included scrap metal, tires, wood, and concrete construction debris. Contaminants present in the waste would have been deposited in the immediate area of disposal and could have migrated to shallow groundwater and intermittent streams that border the site.

1.3.2 Topography and Surface Features

As shown on Figure 1-3, the top of the landfill is relatively flat and slopes steeply to the west, north, and northeast toward intermittent streams. The landfill covers an area of approximately 0.85 acres, and the surface of the site is mostly covered with grasses, with some trees present. The area surrounding the landfill is wooded, and trees have grown on the landfill slopes. Site observations indicate that the landfill was probably layered, with soil pushed south to north toward the toe of the landfill.

Intermittent streams located west and northeast of the landfill join north of the site and flow toward Mattawoman Creek, which is located more than 2,000 feet north of Site 38. Precipitation either infiltrates into the soil or runs off into the intermittent streams. There are no obvious drainage channels on the surface or slopes of the landfill.

1.3.3 Site Geology/Soils

Sample log sheets for soil samples collected during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) and SSP investigation indicate that surface soil at the site consists mostly of sandy silt or silty sand with varying amounts of gravel and clay.

The RFI/Verification Investigation (VI) Report (B&R Environmental, 1998) indicated that subsurface materials were relatively consistent vertically and horizontally across the study area. Surficial deposits generally consisted of yellow brown clay, silt, and sand mixtures and ranged in thickness from 12 to 20 feet. These surface materials were underlain by a distinct dark gray silt and fine sand with shell fragments that ranged in thickness from 20 feet at the western edge of the landfill to 43 feet at the southeastern corner of the site. The shell fragment layer was underlain by a distinct green sand overlying a very stiff clay. A thin soft clay overlies the green sand in the western portion of the site. No waste materials were encountered.

No soil borings were advanced during the 2005 SSP investigation. Four soil borings were advanced during the 2007 Expanded SSP investigation and converted into monitoring wells. Two soil borings were advanced upgradient of the landfill. The subsurface materials encountered in these borings were similar to those encountered during the RFI. Two soil borings were installed downgradient of the landfill, near an intermittent stream. The borings were advanced to depths of 8 to 10 feet, and dark grey sand and gravel were encountered. Olive grey silty sand was encountered at the bottom of one of the borings. No waste materials were encountered.

1.3.4 Site Hydrogeology

Four monitoring wells were installed during the RFI in 1997 (RPLMW01D, RPLMW02, RPLMW03, and RPLMW04D). Shallow wells (piezometers) were installed at two of these locations to form well clusters (RPLMW01S and RPLMW04S). Four more monitoring wells were installed during the Expanded SSP investigation in 2007, including a well cluster upgradient of the landfill (RPLMW05 and RPLMW06). Monitoring wells RPLMW07 and RPLMW08 were installed at the toe of the landfill slope near the intermittent stream to evaluate the potential for downgradient contaminant migration.

Water level measurements taken during the 1997 RFI, the 2005 SSP investigation, and the 2007 Expanded SSP investigation all indicate that groundwater is encounter in both shallow and deep zones. Shallow groundwater occurs in the sandy surface deposits above the dark grey silt and fine sand layer encountered at about 20 below ground surface (bgs). Below the low permeability dark grey silt and fine sand layer, the deep water bearing zone is encounter in the green sand layer overlying a very stiff clay. Boring logs and water level measurements indicate that the deep zone is under semi-confined conditions. At cluster locations, water level measurements indicate a downward vertical gradient. The general groundwater flow direction in both the shallow and deep zones is to the northwest (Figures 1-4 and 1-5).

1.4 PREVIOUS INVESTIGATIONS

1.4.1 Initial Assessment Study

Site 38 was identified as a landfill in the Initial Assessment Study (IAS) (Hart, 1983). A site visit during the IAS indicated the presence of metal parts in addition to biodegradable material such as wood on the surface of the site. The metal objects included garbage cans, 55-gallon drums, office furniture, a rusted land mine, and a projectile (light blue in color and approximately 6 inches in diameter) that the field investigators believed to be an inert round. IAS field personnel also believed that all the observed containers were empty. The IAS did not include a recommendation concerning future actions at Site 38.

1.4.2 RCRA Facility Investigation

An RFI conducted at the site in 1997 (B&R Environmental, 1998) reported that visible wastes included pieces of metal, rusted empty 55-gallon drums, tires, wood, and concrete construction debris. During the RFI, soil borings were advanced and converted into groundwater monitoring wells. Surface soil, subsurface soil, composite soil, groundwater, surface water, and sediment samples were collected (Figure 1-6) and analyzed for RCRA Appendix IX volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals. Benzo(a)pyrene was detected in one surface soil sample at 1400 micrograms per kilogram (µg/kg). Details on the RFI activities and results are provided in the RFI/Verification Investigation Report (B&R Environmental, 1998).

1.4.3 Site Visit

A site visit was conducted in April 2003 in preparation for the Site 38 SSP investigation. This visit verified that previously observed site conditions were essentially unchanged.

1.4.4 Site Screening Process

1.4.4.1 Site Screening Process Investigation

The 2005 SSP investigation was conducted to identify the presence or absence of contamination at Site 38. The field investigation included collection of four surface soil, six shallow groundwater (unfiltered), six groundwater (filtered), three surface water (unfiltered), and four sediment samples. Surface soil samples were collected from the surface of the landfill. Surface water and sediment samples were collected from two locations in the intermittent stream west of the landfill. Groundwater samples were collected from all monitoring wells (RPLMW01D, RPLMW02, RPLMW03, and RPLMW04D) and piezometers (RPLMW01S and RPLMW04S). Sample locations are shown on Figure 1-7. All samples were analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, explosives, nitrocellulose, nitroglycerin, nitroguanidine, Target Analyte List (TAL) metals, hexavalent chromium and cyanide.

Several VOCs, SVOCs [mostly polynuclear aromatic hydrocarbons (PAHs)], metals and one explosive were detected in surface soil samples. Two VOCs, one SVOC, and many metals were detected in subsurface soil samples. One VOC, one SVOC, one explosive, and many metals were detected in surface water. Four VOCs, many SVOCs (mostly PAHs), three explosives, and many metals were detected in sediment. Two VOCs, several SVOCs, one explosive, and many metals were detected in unfiltered groundwater samples collected in 2005.

During the 2007 Expanded SSP investigation, four monitoring wells were installed, two upgradient from the landfill (RPLMW05 and RPLMW06) and two at the toe of the landfill slope (RPLMW07 and RPLMW08). Groundwater samples, 10 filtered and 10 unfiltered, were collected from all new and existing monitoring wells and piezometers. Sample locations are shown on Figure 1-5. All samples were analyzed for TCL VOCs, TCL SVOCs, explosives, nitrocellulose, nitroglycerin, nitroguanidine, TAL metals, hexavalent chromium, and cyanide. Two VOCs, one SVOC, five explosives, and several metals were detected in unfiltered groundwater samples from the 2007 Extended SSP investigation. SSP analytical results by medium are summarized in Tables 1-1 through 1-5.

The field investigations are fully described in the SSP Report (Tetra Tech, 2008).

1.4.4.2 Human Health Risk Screening Evaluation

The following section provides a summary of the risk screening evaluation conducted as part of the SSP. Additional details are provided in the SSP Report (Tetra Tech, 2008).

Based on current and anticipated future land use and the location of the site, military personnel, civilian employees, contractors, and trespassers were considered the most likely human receptors. However, to evaluate the site on a conservative basis, risks were only evaluated based on a hypothetical future residential exposure scenario. The risk screening evaluation included a comparison of maximum detected concentrations in soil, groundwater, surface water, and sediment to United States Environmental Protection Agency (EPA) risk-based screening levels and estimation of incremental lifetime cancer risks (ILCRs) for carcinogens and hazard indices (HIs) for non-carcinogens. The ILCRs and HIs were estimated as ratios of maximum concentrations to risk screening criteria.

The estimated total ILCR for all media for hypothetical future residents is $2.7X10^{-4}$, which is greater than the EPA acceptable risk range of $1X10^{-4}$ to $1X10^{-6}$. The estimated ILCR for exposure to all soil is $1.7X10^{-4}$, and the primary risk drivers are benzo(a)pyrene and arsenic. Benzo(a)pyrene was detected at 1400 µg/kg in a surface soil sample while arsenic was detected at an average concentration of 3.2 milligrams per kilogram (mg/kg) in 12 soil samples. There were no unacceptable carcinogenic risks to human health associated with exposure to groundwater, surface water, or sediment.

The estimated total cumulative HI is 5.87, which is greater than the EPA threshold of 1.0. Even when target organs were considered, the cumulative HI for several target organs is greater than 1.0 for soil and groundwater. The primary risk driver for soil is arsenic, and the primary risk driver for groundwater is manganese. Manganese was detected in all 10 groundwater samples collected at the site at an average concentration of 497 micrograms per liter. There are no unacceptable non-carcinogenic risks for exposure to surface water or sediment.

The human health risk screening evaluation also concluded that migration of chemicals detected in soil to shallow groundwater is not considered to be problematic.

In summary, a potential risk to human health associated with exposure to chemicals is from exposure to soil and groundwater under a hypothetical residential exposure scenario. COCs include arsenic and benzo(a)pyrene in soil and manganese in groundwater. There is also an inherent risk from exposure to buried landfill waste at the site.

1.4.4.3 Ecological Risk Screening Evaluation

This section provides a summary of the ecological risk screening evaluation, which included comparison of detected chemical concentrations in Site 38 samples to EPA ecological screening levels and alternative guidelines and food-chain modeling. Additional details are provided in the SSP Report (Tetra Tech, 2008).

There are minimal risks to plants from exposure to PAHs in surface soil. No risks to soil invertebrates are expected. Potential risks to aquatic organisms exposed to surface water are not related to site activities because maximum chemical concentrations were detected in a sample collected upstream of the landfill. Potential risks to sediment invertebrates are not expected. The results from food-chain modeling indicate that there are no unacceptable risks to wildlife.

1.4.5 <u>Geophysical Survey</u>

A geophysical survey was conducted across Site 38 in December 2009 to further define the limits of waste present at the site. The geophysical survey was a follow-up to the 2008 SSP Report. The technical memorandum detailing the results of the investigation is provided in Appendix A.

Interpretations presented in the memorandum were made taking into account geophysical and other available supporting data (i.e., soil borings and visual evidence of waste) to the extent possible to estimate the area and relative volume of the landfill. In general, the data indicate that the waste was predominantly placed on the slope, which confirmed the predicted limits of waste disposal at the site. The landfill area was estimated at 96,000 square feet, with an estimated depth of 8 to 16 feet bgs. The estimated landfill boundary based on the results of the geophysical survey is identified on Figure 1-8.

1.4.6 <u>Test Trenching</u>

To verify the findings of the geophysical survey and define the limits of waste present onsite, a series of test trenches were excavated at Site 38. An initial test trench was excavated at the site May 2011 near the drainage culvert on the east side of the landfill in which limited fill or waste was identified; however, the base of a 5-inch naval projectile [classified as munitions debris (MD)] was discovered within the trench. There are no documented references to munitions and explosives of concern (MEC) and/or Material Potentially Presenting an Explosive Hazard (MPPEH) being recovered at Site 38 from any prior investigation; however, due to the landfill activities it has been inferred that the MD item was dumped at the location.

Following the development of the appropriate explosives safety plans, additional test trenching was conducted at Site 38 in May 2012. Ten test trenches were excavated during this effort at locations shown on Figure 1-9. A limited volume of waste and fill was identified in the test trenches while no MEC or MPPEH was identified in any excavation. Descriptions of the test trenches are provided in Appendix B.

As a result of the test trenching, the limits of the landfill were refined. The majority of waste present at Site 38 is present on the surface and slopes of the site, with limited waste buried in the subsurface. The updated limits are shown on Figure 1-9.

1.5 SITE WASTE MANAGEMENT PRACTICES

Site 38 is an inactive landfill that was originally intended for the disposal of biodegradable wastes. Ash from a thermal treatment tank was reportedly disposed of at the site on a one-time basis. Wastes observed during previous site visits included scrap metal, tires, wood, and concrete construction debris. Any waste constituents would have been deposited directly in the waste or migrated to shallow groundwater or the intermittent streams that border the site.

Past activities at Site 38 have resulted in the release of hazardous substances, pollutants, contaminants, hazardous wastes, or hazardous constituents at concentrations of potential concern. Potential human health risk associated with the site would be related to direct contact with surface soil and waste within the limits of the landfill and through use of shallow groundwater at the site as a potable source. COCs include arsenic and benzo(a)pyrene in soil, and manganese in groundwater.

TABLE 1-1

SUMMARY OF DETECTED CONCENTRATIONS - SURFACE SOIL
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND
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PARAMETER	RPLCP01			RPLCP02	RPLCP03	RPLCP04	RPLSS01			RPLSS02
	RPLCP0010101	RPLCP0010101-AVG	RPLCP0010101-D	RPLCP0020101	RPLCP0030101	RPLCP0040101	RPLSS0010101	RPLSS0010101-AVG	RPLSS0010101-D	RPLSS0020101
	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
	7/31/1997	7/31/1997	7/31/1997	7/31/1997	7/31/1997	7/31/1997	7/11/1997	7/11/1997	7/11/1997	7/12/1997
Volatile Organics (µg/kg)										
4-METHYL-2-PENTANONE	6 U	6 U	6 U	3 J	6 U	6 U	5 U	5 U	5 U	6 U
ACETONE	70 J	46.5	23 J	11 U	11 U	23 J	41 B	11 U	11 U	58 B
METHYLENE CHLORIDE	14 B	14 B	14 B	9 B	20 B	22 B	5 U	5 U	2 B	6 U
TOLUENE	6 U	6 U	6 U	6 U	6 U	6 U	5 U	5 U	5 U	6 U
TRANS-1,2-DICHLOROETHENE	6 U	6 U	6 U	6 U	6 U	1 J	5 U	5 U	5 U	6 U
TRICHLOROETHENE	6 U	6 U	6 U	6 U	1 J	6 U	5 U	5 U	5 U	6 U
Semivolatile Organics (µg/kg)										
ACENAPHTHENE	370 U	370 U	370 U	38 J	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
ACENAPHTHYLENE	370 U	370 U	370 U	600	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
ANTHRACENE	370 U	370 U	370 U	170 J	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
BENZALDEHYDE										
BENZO(A)ANTHRACENE	370 U	370 U	370 U	920	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
BENZO(A)PYRENE	370 U	370 U	370 U	1400 J	370 UJ	380 UJ	350 UJ	350 UJ	350 UJ	390 UJ
BENZO(B)FLUORANTHENE	370 U	370 U	370 U	1300 J	370 UJ	380 UJ	350 UJ	350 UJ	350 UJ	390 UJ
BENZO(G,H,I)PERYLENE	370 U	37 J	37 J	1500 J	370 UJ	380 UJ	350 UJ	350 UJ	350 UJ	390 UJ
BENZO(K)FLUORANTHENE	370 U	370 U	370 U	970 J	370 UJ	380 UJ	350 UJ	350 UJ	350 UJ	390 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	370 U	370 U	370 U	370 U	370 U	380 U	350 UJ	350 UJ	350 UJ	96 J
CHRYSENE	370 U	370 U	370 U	970	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
FLUORANTHENE	370 U	370 U	370 U	1000	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
FLUORENE	370 U	370 U	370 U	96 J	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
INDENO(1,2,3-CD)PYRENE	370 U	370 U	370 U	1200	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
NAPHTHALENE	370 U	370 U	370 U	40 J	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
PHENANTHRENE	370 U	370 U	370 U	440	370 U	380 U	350 UJ	350 UJ	350 UJ	390 UJ
PYRENE	370 U	370 U	370 U	1800	59 J	380 U	350 UJ	350 UJ	350 UJ	390 UJ
Explosives (mg/kg)										
NITROCELLULOSE										
Inorganics (mg/kg)										
ALUMINUM										
ANTIMONY	0.76 B	0.79 B	0.82 B	0.72 B	1.2 B	0.88 B	0.31 L	0.21 L	0.21 UL	0.31 L
ARSENIC	6.2 K	5.85 K	5.5 K	2.8 K	4.2 K	3.7 K	1.9	1.19	0.96 B	2.5
BARIUM	18.4	18.35	18.3	28.9	40.9	42.7	16.0	15.25	14.5	18.6
BERYLLIUM	0.42	0.38	0.34	0.19	0.21	0.20	0.26	0.235	0.21	0.32
CADMIUM	0.12 U	0.12 U	0.12 U	0.15 K	0.14 U	0.14 U	0.22 K	0.185 K	0.15 K	0.33 K
CHROMIUM	24.9 K	23.7 K	22.5 K	13.3 K	16.5 K	18.4 K	8.2 J	7.05	5.9 J	10.3 J
COBALT	2.7	2.95	2.6	4.5	4.6	3.2	1.8	1.75	1.7	1.6
COPPER	10.0	8.35	6.7	12.9	11.3	9.4	2.7 B	2.35 B	2.0 B	3.3 B
IRON										
LEAD	7.2 K	7.1 K	7.0 K	20.3 K	20.1 K	14.7 K	7.8 J	6.05	4.3 J	9.3 J
MANGANESE										
MERCURY	0.06	0.055	0.05	0.31	0.03	0.05	0.02	0.02	0.02	0.07
NICKEL	4.9	4.6	4.3	8.2	8.7	5.5	3.7	3.8	3.9	5.2
SELENIUM	1.1 L	0.985	0.87 L	0.42 L	0.53 L	0.74 L	0.48	0.39	0.30	0.63
Inorganics (mg/kg) (continued)										
THALLIUM	0.83 B	0.57 B	0.31 B	0.24 U	0.28 U	0.37 B	0.43 B	0.23 U	0.23 U	0.29 U
VANADIUM	30.6	28.45	26.3	21.4	28.9	31.5	13.5	11	8.5	12.5

TABLE 1-1

SUMMARY OF DETECTED CONCENTRATIONS - SURFACE SOIL
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLCP01			RPLCP02	RPLCP03	RPLCP04	RPLSS01			RPLSS02
	RPLCP0010101 0 - 1 7/31/1997	RPLCP0010101-AVG 0 - 1 7/31/1997	RPLCP0010101-D 0 - 1 7/31/1997	RPLCP0020101 0 - 1 7/31/1997	RPLCP0030101 0 - 1 7/31/1997	RPLCP0040101 0 - 1 7/31/1997	RPLSS0010101 0 - 1 7/11/1997	RPLSS0010101-AVG 0 - 1 7/11/1997	RPLSS0010101-D 0 - 1 7/11/1997	RPLSS0020101 0 - 1 7/12/1997
ZINC	19.5 J	18.45	17.4 J	28.2 J	30.7 J	32.0 J	11.7 J	10.95	10.2 J	14.8 J
Miscellaneous Parameters (mg/kg)										
CYANIDE										

B - Detected in blank; false positive.
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
UJ - Not detected; estimated detection limit.

TABLE 1-1

SUMMARY OF DETECTED CONCENTRATIONS - SURFACE SOIL
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLSS03	RPLSS04			S38SS005	S38SS006	S38SS007	S38SS008		
	RPLSS0030101	RPLSS0040101	RPLSS0040101-AVG	RPLSS0040101-D	S38SS0050102	S38SS0060102	S38SS0070102	S38SS0080102	S38SS0080102-AVG	S38SS0080102-D
	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
	7/12/1997	7/15/1997	7/15/1997	7/15/1997	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005
Volatile Organics (µg/kg)										
4-METHYL-2-PENTANONE	6 UJ	6 U	5.5 U	5 U	12 U	12 U	17 U	14 U	14 U	14 U
ACETONE	2200	80 B	85 B	90 B	8 J	12 U	120 J	14 U	14 U	14 U
METHYLENE CHLORIDE	2 B	7 B	7 B	7 B	12 U	4 J	17 U	14 U	5 J	5 J
TOLUENE	6 UJ	2 J	2 J	5 U	12 U	12 U	17 U	1 J	1 J	14 U
TRANS-1,2-DICHLOROETHENE	6 UJ	6 U	5.5 U	5 U	12 U	12 U	17 U	14 U	14 U	14 U
TRICHLOROETHENE	6 UJ	6 U	5.5 U	5 U	12 U	12 U	17 U	14 U	14 U	14 U
Semivolatile Organics (µg/kg)										
ACENAPHTHENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
ACENAPHTHYLENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
ANTHRACENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
BENZALDEHYDE					390 U	61 J	110 J	89 J	82.5 J	76 J
BENZO(A)ANTHRACENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
BENZO(A)PYRENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
BENZO(B)FLUORANTHENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
BENZO(G,H,I)PERYLENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
BENZO(K)FLUORANTHENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
BIS(2-ETHYLHEXYL)PHTHALATE	390 UJ	400 UJ	380 UJ	360 UJ	170 B	530	200 B	68 B	184 B	300 B
CHRYSENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
FLUORANTHENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
FLUORENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
INDENO(1,2,3-CD)PYRENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
NAPHTHALENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
PHENANTHRENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
PYRENE	390 UJ	400 UJ	380 UJ	360 UJ	390 U	430 U	470 U	460 U	465 U	470 U
Explosives (mg/kg)										
NITROCELLULOSE					2.5 L	2.7 L	1.1 J	2.3 L	1.505 L	0.71 J
Inorganics (mg/kg)										
ALUMINUM					2720	3890	3090	3670	3260	2850
ANTIMONY	0.26 UL	0.52 B	0.545 B	0.57 B	0.36 B	0.36 UL	0.38 B	0.45 B	0.445 B	0.44 B
ARSENIC	1.8	3.1	3.55	4.0	2.6	2.3	2.4	5.9	5.05	4.2
BARIUM	12.5	21.7	23.7	25.7	23.6	31.3	24	22.7	19.6	16.5
BERYLLIUM	0.1 B	0.39 K	0.40 K	0.41 K	0.29	0.31	0.30	0.57	0.495	0.42
CADMIUM	0.25 K	0.13 U	0.125 U	0.12 U	0.12	0.09	0.10	0.17	0.095	0.039 U
CHROMIUM	9.6 J	20.4	21.2	22.0	10.4	7.1	10.9	22.4	20	17.6
COBALT	0.84	2.7	2.9	3.1	1.3	2.9	1.3 B	1.2 B	1.03 B	0.86 B
COPPER	4.5 B	3.4 B	3.45 B	3.5 B	5.4 B	8.1 B	6.2 B	5.4 B	5.05 B	4.7 B
IRON					5030	5870	5790	12800	11315	9830
LEAD	3.5 J	5.3 K	4.9 K	4.5 K	24.8	23.9	18.8	16.3	14.75	13.2
MANGANESE					199 K	266 K	140 K	363 K	305.5 K	248 K
MERCURY	0.08	0.01 B	0.02 B	0.03 B	0.054 U	0.053 U	0.062 U	0.056 U	0.058 U	0.06 U
NICKEL	2.2	5.9	6.35	6.8	4.1 K	7.9 K	4.2 K	7.9 K	6.75 K	5.6 K
SELENIUM	0.65	0.64	0.695	0.75	0.49 U	0.53 U	0.57 U	0.60 U	0.595 U	0.59 U
Inorganics (mg/kg) (continued)										
THALLIUM	0.28 U	0.52 B	0.46 K	0.66 K	0.32 U	0.36 U	0.38 U	0.40 U	0.395 U	0.39 U
VANADIUM	13.6	21.5	23.75	26.0	13.9	12.8	16	20.6	18.2	15.8

TABLE 1-1

SUMMARY OF DETECTED CONCENTRATIONS - SURFACE SOIL
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLSS03	RPLSS04			S38SS005	S38SS006	S38SS007	S38SS008		
	RPLSS0030101	RPLSS0040101	RPLSS0040101-AVG	RPLSS0040101-D	S38SS0050102	S38SS0060102	S38SS0070102	S38SS0080102	S38SS0080102-AVG	S38SS0080102-D
	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
	7/12/1997	7/15/1997	7/15/1997	7/15/1997	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005
ZINC	7 J	19.4	21.25	23.1	21.6	28.8	19.2 B	28.3	24.75	21.2
Miscellaneous Parameters (mg/kg)										
CYANIDE					0.84	0.13 U	0.14 U	0.17	0.16	0.15

B - Detected in blank; false positive.
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
UJ - Not detected; estimated detection li

TABLE 1-2

SUMMARY OF DETECTED CONCENTRATIONS - SUBSURFACE SOIL
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLSB01 RPLSB0010101 16 - 18 7/11/1997	RPLSB01 RPLSB0010201 30 - 32 7/11/1997	RPLSB01 RPLSB0010301 4 - 6 7/12/1997	RPLSB01 RPLSB0010401 10 - 12 7/11/1997	RPLSB02 RPLSB0020101 4 - 6 7/12/1997	RPLSB02 RPLSB0020201 10 - 12 7/12/1997	RPLSB02 RPLSB0020301 14 - 16 7/12/1997	RPLSB03 RPLSB0030101 4 - 6 7/12/1997	RPLSB03 RPLSB0030201 10 - 12 7/12/1997	RPLSB04 RPLSB0040101 4 - 6 7/15/1997	RPLSB04 RPLSB0040201 10 - 12 7/15/1997	RPLSB04 RPLSB0040301 14 - 16 7/15/1997
Volatile Organics (µg/kg)												
ACETONE	160 B	85 B	38 B	210 B	12 UJ	5000 K	12 U	1800	3800	12 U	610	46 B
CARBON DISULFIDE	6	6 U	6 U	6 U	6 UJ	6 UJ	6 U	6 UJ	6 UJ	6 U	6 U	6 U
Semivolatile Organics (µg/kg)												
BIS(2-ETHYLHEXYL)PHTHALATE	410 UJ	430 UJ	390 UJ	400 UJ	270 J	57 J	190 J	370 UJ	390 UJ	400 UJ	410 UJ	420 UJ
Inorganics (mg/kg)												
ANTIMONY	0.53 L	0.34 L	0.43 L	0.62 L	0.86 L	1.0 L	0.39 L	0.21 UL	0.42 L	1.5 B	1.4 B	1.5 B
ARSENIC	9.4	7.5	2.4	3.9	13.0	39.6	12.6	2	7.6	7.7	12.1	10.1
BARIUM	21.7	22.0	11.2	14.2	8.2	17.2	30.8	15	12.5	19.3	30.0	24.3
BERYLLIUM	0.41	0.69	0.42	1.0	1.0	1.9	0.50	0.12	0.33	1.4 K	1.8 K	1.9 K
CADMIUM	0.89	0.51 K	0.44 K	0.83 K	0.81 K	1.5	1.4	0.23 K	0.37 K	0.14 U	0.16 U	0.14 U
CHROMIUM	34.9 J	30.2 J	42.4 J	47.2 J	65.6 J	89.6 J	38.0 J	10 J	38.0 J	113	83.5	99.3
COBALT	0.69	2.2	0.63	2.8	1.0	3.2	0.70	0.86	0.34	1.7	2.1	0.25
COPPER	3.5 B	3.8 B	3.4 B	3.7 B	6.4	6.9	4.4 B	4.5 B	5.2	4.4 B	3.8 B	3.7 B
LEAD	3.6 J	3.8 J	4.5 J	4.8 J	4.5 J	5.7 J	3.2 J	4 J	3.4 J	5.7 K	5.2 K	4.3 K
MERCURY	0.02	0.02 U	0.03	0.02	0.03	0.02 U	0.02 U	0.07	0.02	0.02	0.02 U	0.02 U
NICKEL	7.5	7.7	2.5	8.6	5.7	25.8	10.7	3	1.9	9.5	16.7	9.2
SELENIUM	2.2	1.7	1.3	2.0	3.4	3.6	2.8	0.68	2.6	1.0	1.9	2.2
THALLIUM	0.55 B	0.77 B	0.29 U	1.3 B	1.2 B	1.9 B	1.1 B	0.23 B	0.66 B	0.66 K	2.2 K	2.7 K
TIN	3.1 B	2.9 B	2.9 B	2.8 B	2.9 B	4.1 L	2.5 B	1.9 B	2.0 B	3.8 B	4.2 B	3.9 B
VANADIUM	27.9	30.6	41.8	29.9	51.8	56.4	26.1	16.7	28.4	84.2	59.9	79.6
ZINC	24.1 J	34.4 J	14.6 J	37.5 J	26.5 J	100 J	28.5 J	10.3 J	8.2 J	39.4	43.6	37.5

B - Detected in blank; false positive.
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
UJ - Not detected; estimated detection limit.
UL - Not detected; detection limit biased low.

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW01 S38MW0010102 S38MW0010102-F 20050728	RPLMW01S RPLMW01S0103 RPLMW01S0103F 20070124	RPLMW01D RPLMW001U001 RPLMW001F001 19970806	RPLMW01D S38MW0010102D NA 20050726	RPLMW01D S38MW0010102D-D NA 20050726	RPLMW01D S38MW01D0103 S38MW01D0103F 20070123
Volatile Organics (µg/L)						
2-BUTANONE	5 U	10 U	10 UR	5 U	5 U	10 U
ACETONE	5 UJ	10 U	10 U	5 UJ	5 UJ	10 U
CARBON DISULFIDE	0.50 U	10 U	6	0.50 U	0.50 U	10 U
CHLOROFORM	0.50 U	10 U	2 J	0.50 U	0.50 U	10 U
TOLUENE	0.50 U	10 U	7	0.50 U	0.50 U	10 U
TRICHLOROETHENE	0.50 U	10 U	5 U	0.31 J	0.50 U	10 U
Semivolatile Organics (µg/L)						
2-METHYLPHENOL	10 U	11 U	11 U	10 U	10 U	11 U
4-METHYLPHENOL	10 U	11 U		10 U	10 U	11 U
ACETOPHENONE	10 U	11 U	11 U	10 U	10 U	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	11 U	1 J	10 U	10 U	11 U
DI-N-BUTYL PHTHALATE	10 U	11 U	1 J	10 U	10 U	11 U
DIETHYL PHTHALATE	10 U	11 U	3 J	10 U	10 U	11 U
DIMETHYL PHTHALATE	10 U	11 U	11 U	10 U	10 U	11 U
ISOPHORONE	10 U	11 U	11 U	10 U	10 U	11 U
NAPHTHALENE	10 U	11 U	11 U	10 U	10 U	11 U
PHENOL	10 U	11 U	11 U	10 U	10 U	11 U
Explosives (µg/L)						
HMX	0.1 U	0.47 U		0.10 U	0.10 U	0.46 U
NITROBENZENE	0.1 U	0.47 U		0.10 U	0.10 U	0.46 U
NITROGUANIDINE	20 U	10 U		20 U	20 U	10 U
RDX	0.1 U	0.47 U		0.10 U	0.10 U	0.46 U
Inorganics (µg/L)						
ALUMINUM	605	50 U		61.3 B	30.3 B	50 U
ARSENIC	5.7	3 U	1.9 UL	2 U	3	3 U
BARIUM	36.8 L	25.1	60.3	54.8	55.1	46.5
CADMIUM	0.26 K	1 U	1.3 U	0.20 U	0.20 U	1 U
CHROMIUM	2.7 K	2 U	2.5	0.67 B	0.56 B	2 U
COBALT	1.4 L	5 U	0.7 U	0.40 U	0.40 U	5 U
COPPER	1 U	5 U	3.3 U	1.1 B	2.9 B	5 U
IRON	2480	5690		205	190	106
LEAD	2.3 J	2.8 B	5.2 B	0.90 UL	0.90 UL	1.5 UJ
MANGANESE	1580	2250		70.8	71.7	87.5
MERCURY	0.13 U	0.08 U	0.13	0.13 U	0.13 U	0.08 U
NICKEL	4.4 B	5 U	1.1 U	0.70 U	0.70 U	5 U
SELENIUM	6.5 J	3 U	2.5 U	3 UL	3 UL	3 U
VANADIUM	2.2 L	5 U	2.4 B	0.42 B	0.40 U	5 U
ZINC	14 B	5 U	6.4 B	11.4 B	13.2 B	5 U

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW01 S38MW0010102 S38MW0010102-F 20050728	RPLMW01S RPLMW01S0103 RPLMW01S0103F 20070124	RPLMW01D RPLMW001U001 RPLMW001F001 19970806	RPLMW01D S38MW0010102D NA 20050726	RPLMW01D S38MW0010102D-D NA 20050726	RPLMW01D S38MW01D0103 S38MW01D0103F 20070123
Inorganics, Filtered (µg/L)						
ARSENIC	5.8	3 U	1.9 UL			3 U
BARIUM	32.9 L	25.1	60.3			46.2
COBALT	1.2 L	5 U	0.7 U			5 U
COPPER	1 U	5 U	3.3 U			5 U
IRON	449	4090				67
LEAD	1.9 J	5.4 B	2.3 B			1.5 UJ
MANGANESE	1550	2150				89.6
MERCURY	0.10 U	0.08 U	0.16			0.08 U
NICKEL	3.3 B	5 U	1.1 U			5 U
SELENIUM	6.2 J	3 U	2.5 U			3 U
VANADIUM	0.40 UL	5 U	0.7 U			5 U
ZINC	7.3 B	5 U	6.1 B			5 U
Miscellaneous Parameters (µg/L)						
CYANIDE	2 U	5 UL		2 U	4.9	5 UL
PERCHLORATE		0.5 U				0.5 U

B - Detected in blank; false positive
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
UJ - Not detected; detection limit estimated.
UL - Not detected; detection limit biased low.
UR - Non-detect result rejected.

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW02 RPLMW002U001 RPLMW002F001 19970812	RPLMW02 S38MW0020102 NA 20050728	RPLMW02 S38MW020103 S38MW020103F 20070122	RPLMW03 RPLMW003U001 RPLMW003F001 19970806	RPLMW03 S38MW0030102 NA 20050726	RPLMW03 S38MW030103 S38MW030103F 20070123
Volatile Organics (µg/L)						
2-BUTANONE	10 UR	5 U	10 U	10 UR	5 U	10 U
ACETONE	95	5 UJ	10 U	10 U	5 UJ	10 U
CARBON DISULFIDE	5 U	0.50 U	10 U	5 U	0.50 U	10 U
CHLOROFORM	5 U	0.50 U	10 U	5 U	0.50 U	10 U
TOLUENE	5 U	1.3	10 U	5 U	0.50 U	10 U
TRICHLOROETHENE	5 U	5.7	10 U	5 U	0.86	10 U
Semivolatile Organics (µg/L)						
2-METHYLPHENOL	11 U	10 U	12 U	11 U	90 J	11 U
4-METHYLPHENOL		10 U	12 U		50 J	11 U
ACETOPHENONE	11 U	10 U	12 U	11 U	230	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	10 U	12 U	4 J	100 U	11 U
DI-N-BUTYL PHTHALATE	11 U	10 U	12 U	11 U	100 U	11 U
DIETHYL PHTHALATE	11 U	10 U	12 U	11 U	100 U	11 U
DIMETHYL PHTHALATE	11 U	10 U	12 U	11 U	14 J	11 U
ISOPHORONE	11 U	10 U	12 U	11 U	270	11 U
NAPHTHALENE	11 U	10 U	12 U	11 U	100 U	11 U
PHENOL	11 U	10 U	12 U	11 U	430	11 U
Explosives (µg/L)						
HMX		0.013 J	0.46 U		0.10 U	0.49 U
NITROBENZENE		0.1 U	0.46 U		0.10 U	0.49 U
NITROGUANIDINE		20 U	10 U		20 U	10 U
RDX		0.1 U	0.46 U		0.10 U	0.49 U
Inorganics (µg/L)						
ALUMINUM		60.4 B	50 U		34.7 B	50 U
ARSENIC	1.9 UL	2.5	3 U	3.0 L	2.8	3 U
BARIUM	55.8	66.7	56.9	64.3	89.6	61.4
CADMIUM	1.3 U	0.20 U	1 U	1.3 U	0.20 U	1 U
CHROMIUM	16	0.81 B	2 U	8	0.88 B	2 U
COBALT	0.78	0.40 U	5 U	0.70 U	0.41	5 U
COPPER	3.3 U	3.1 B	5 U	3.8 B	2 B	5 U
IRON		198	30 U		103	31.2
LEAD	2.7 B	0.90 UL	1.5 UJ	2.8 B	0.90 UL	1.5 UJ
MANGANESE		59.5	51.3		124	182
MERCURY	0.10 U	0.13 U	0.08 U	0.1	0.13 U	0.08 U
NICKEL	11.8	0.70 U	5 U	1.1 U	5.1	5 U
SELENIUM	2.5 UL	3 UL	3 U	2.5 U	3 UL	3 U
VANADIUM	0.85	0.78 B	5 U	6.8	1.2 B	5 U
ZINC	6	15.5 B	5 U	11.0 B	41.5	5 U

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW02 RPLMW002U001 RPLMW002F001 19970812	RPLMW02 S38MW0020102 NA 20050728	RPLMW02 S38MW020103 S38MW020103F 20070122	RPLMW03 RPLMW003U001 RPLMW003F001 19970806	RPLMW03 S38MW0030102 NA 20050726	RPLMW03 S38MW030103 S38MW030103F 20070123
Inorganics, Filtered (µg/L)						
ARSENIC	1.9 UL		3 U	2.2 L		3 U
BARIUM	60.9		55.7	55.8		63.5
COBALT	0.70 U		5 U	0.70 U		5 U
COPPER	3.3 U		5 U	3.3 U		5 U
IRON			30 U			30 U
LEAD	2.2 B		1.5 UJ	2.0 B		1.5 UJ
MANGANESE			53.3			185
MERCURY	0.10 U		0.08 U	0.14		0.08 U
NICKEL	6.8		5 U	1.1 U		5 U
SELENIUM	2.5 UL		3 U	2.5 U		3 U
VANADIUM	0.70 U		5 U	0.92 B		5 U
ZINC	6.9		5 U	4.3 B		5 U
Miscellaneous Parameters (µg/L)						
CYANIDE		2.3	5 UL		2 U	5 UL
PERCHLORATE			0.5 U			0.5 U

B - Detected in blank; false positive
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
UJ - Not detected; detection limit estimated.
UL - Not detected; detection limit biased low.
UR - Non-detect result rejected.

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW04 RPLMW004U001 RPLMW004F001 19970813	RPLMW04 S38MW0040102S NA 20050727	RPLMW04S S38MW04S0103 S38MW04S0103F 20070122	RPLMW04D S38MW0040102D S38MW0040102D-F 20050727	RPLMW04D S38MW04D0103 S38MW04D0103F 20070122	RPLMW05 S38MW050103 S38MW050103F 20070124
Volatile Organics (µg/L)						
2-BUTANONE	10 UR	5 U	10 U	5 U	10 U	10 U
ACETONE	10 U	5 UJ	10 U	5 UJ	10 U	10 U
CARBON DISULFIDE	5 U	0.50 U	10 U	0.50 U	10 U	10 U
CHLOROFORM	5 U	0.50 U	10 U	0.50 U	10 U	10 U
TOLUENE	5 U	0.50 U	10 U	0.50 U	10 U	1.2 J
TRICHLOROETHENE	5 U	0.35 J	10 U	0.49 J	10 U	10 U
Semivolatile Organics (µg/L)						
2-METHYLPHENOL	11 U	10 U	10 U	10 U	12 U	11 U
4-METHYLPHENOL		10 U	10 U	10 U	12 U	11 U
ACETOPHENONE	11 U	10 U	10 U	10 U	12 U	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	10 U	10 U	10 U	12 U	11 U
DI-N-BUTYL PHTHALATE	11 U	10 U	10 U	10 U	12 U	11 U
DIETHYL PHTHALATE	11 U	10 U	10 U	10 U	12 U	11 U
DIMETHYL PHTHALATE	11 U	10 U	10 U	10 U	12 U	11 U
ISOPHORONE	11 U	10 U	10 U	10 U	12 U	11 U
NAPHTHALENE	11 U	10 U	10 U	10 U	12 U	11 U
PHENOL	11 U	10 U	10 U	10 U	12 U	11 U
Explosives (µg/L)						
HMX		0.10 U	0.16 J	0.1 U	0.47 U	0.49 U
NITROBENZENE		0.10 U	0.47 U	0.1 U	0.47 U	0.26 J
NITROGUANIDINE		20 U	10 U	20 U	10 U	12
RDX		0.10 U	0.47 U	0.1 U	0.47 U	0.26 J
Inorganics (µg/L)						
ALUMINUM		18 U	50 U	525	98.3	149
ARSENIC	1.9 UL	2 U	3 U	3.1	3 U	3 U
BARIUM	26.4	68.6	57.5	42.8	46.4	130
CADMIUM	1.3 U	0.20 U	1 U	0.20 U	1 U	1 U
CHROMIUM	29.6	0.51 B	2 U	1.2 B	2 U	2 U
COBALT	1.2	0.40 UL	5 U	0.43	5 U	8.6
COPPER	7.4	1 U	5 U	5.9 B	5 U	5 U
IRON		61.5 B	30 U	622	159	626
LEAD	4.5 B	0.90 UL	2.3 B	0.90 UL	1.5 UJ	1.5 UJ
MANGANESE		21.5	4.8	36.8	31.8	1550
MERCURY	0.10 U	0.13 U	0.08 U	0.13 U	0.08 U	0.08 U
NICKEL	15.3	0.70 U	5 U	0.70 U	5 U	5 U
SELENIUM	2.5 UL	3 UL	3 U	3 UL	3 U	3 U
VANADIUM	1.8	0.40 UL	5 U	6.2	5 U	5 U
ZINC	12.6	13.2 B	5 U	22.1 B	5 U	5 U

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW04 RPLMW004U001 RPLMW004F001 19970813	RPLMW04 S38MW0040102S NA 20050727	RPLMW04S S38MW04S0103 S38MW04S0103F 20070122	RPLMW04D S38MW0040102D S38MW0040102D-F 20050727	RPLMW04D S38MW04D0103 S38MW04D0103F 20070122	RPLMW05 S38MW050103 S38MW050103F 20070124
Inorganics, Filtered (µg/L)						
ARSENIC	1.9 UL		3 U	2.4	3 U	3 U
BARIUM	24.7		56	39.1	46.6	126
COBALT	0.83		5 U	0.40 U	5 U	8.4
COPPER	3.3		5 U	1.8 B	5 U	5 U
IRON			30 U	53.5 B	30 U	327
LEAD	2.2 B		1.5 UJ	0.90 UL	1.5 UJ	1.5 UJ
MANGANESE			4.5	22.6	17.8	1480
MERCURY	0.10 U		0.08 U	0.10 U	0.08 U	0.08 U
NICKEL	12.3		5 U	0.70 U	5 U	5 U
SELENIUM	2.5 UL		3 U	3 UL	3 U	3 U
VANADIUM	0.70 U		5 U	5.2	5 U	5 U
ZINC	8.4		5 U	21 B	5 U	5 U
Miscellaneous Parameters (µg/L)						
CYANIDE		3.9	5 UL	2 U	5 UL	5 UL
PERCHLORATE			0.07 J		0.5 U	0.41 J

B - Detected in blank; false positive
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
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UL - Not detected; detection limit biased low.
UR - Non-detect result rejected.

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW06 S38MW060103 S38MW060103F 20070124	RPLMW07 S38MW070103 S38MW070103F 20070124	RPLMW08 S38MW080103 S38MW080103F 20070124	RPLMW08 S38MW080103-D S38MW080103F-D 20070124
Volatile Organics (µg/L)				
2-BUTANONE	10 U	210	10 U	10 U
ACETONE	10 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U
CHLOROFORM	10 U	10 U	10 U	10 U
TOLUENE	10 U	10 U	10 U	10 U
TRICHLOROETHENE	10 U	10 U	10 U	10 U
Semivolatile Organics (µg/L)				
2-METHYLPHENOL	12 U	11 U	11 U	11 U
4-METHYLPHENOL	12 U	11 U	11 U	11 U
ACETOPHENONE	12 U	11 U	11 U	11 U
BIS(2-ETHYLHEXYL)PHTHALATE	12 U	11 U	11 U	11 U
DI-N-BUTYL PHTHALATE	12 U	11 U	11 U	11 U
DIETHYL PHTHALATE	12 U	11 U	11 U	11 U
DIMETHYL PHTHALATE	12 U	11 U	11 U	11 U
ISOPHORONE	12 U	11 U	11 U	11 U
NAPHTHALENE	12 U	11 U	11 U	2.5 J
PHENOL	12 U	11 U	11 U	11 U
Explosives (µg/L)				
HMX	0.42 U	0.49 U	0.49 U	0.44 U
NITROBENZENE	0.42 U	0.49 U	0.49 U	0.44 U
NITROGUANIDINE	10 U	10 U	10 U	10 U
RDX	0.42 U	0.49 U	0.49 U	0.44 U
Inorganics (µg/L)				
ALUMINUM	256	50 U	50 U	50 U
ARSENIC	3 U	3 U	4	3 U
BARIUM	73.2	92.7	64.7	65.3
CADMIUM	1 U	1 U	1 U	1 U
CHROMIUM	2.2	2 U	2 U	2 U
COBALT	5 U	5 U	5 U	5 U
COPPER	5 U	5 U	5 U	5 U
IRON	734	5450	2950	2990
LEAD	1.5 UJ	1.6 B	1.7 B	1.5 UJ
MANGANESE	98.8	593	115	118
MERCURY	0.08 U	0.08 U	0.08 U	0.08 U
NICKEL	5 U	5 U	5 U	5 U
SELENIUM	3 U	3 U	3 U	3 U
VANADIUM	5 U	5 U	5 U	5 U
ZINC	5 U	5 U	5 U	5 U

TABLE 1-3

SUMMARY OF DETECTED CONCENTRATIONS - GROUNDWATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLMW06 S38MW060103 S38MW060103F 20070124	RPLMW07 S38MW070103 S38MW070103F 20070124	RPLMW08 S38MW080103 S38MW080103F 20070124	RPLMW08 S38MW080103-D S38MW080103F-D 20070124
Inorganics, Filtered (µg/L)				
ARSENIC	3 U	3 U	3.2	3.6
BARIUM	69.5	96.7	66.6	67.5
COBALT	5 U	5 U	5 U	5 U
COPPER	5 U	5 U	5 U	5 U
IRON	30 U	5710	2990	3040
LEAD	1.5 UJ	1.5 UJ	1.5 UJ	2 B
MANGANESE	93.6	596	118	121
MERCURY	0.08 U	0.08 U	0.08 U	0.08 U
NICKEL	5 U	5 U	5 U	5 U
SELENIUM	3 U	3 U	3 U	3 U
VANADIUM	5 U	5 U	5 U	5 U
ZINC	5 U	5 U	5 U	5 U
Miscellaneous Parameters (µg/L)				
CYANIDE	5 UL	5 UL	5 UL	5 UL
PERCHLORATE	0.5 U	0.5 U	0.5 U	0.5 U

B - Detected in blank; false positive
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.
UJ - Not detected; detection limit estimated.
UL - Not detected; detection limit biased low.
UR - Non-detect result rejected.

TABLE 1-4

SUMMARY OF DETECTED CONCENTRATIONS - SURFACE WATER
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLSW01	RPLSW02			RPLSW03	S38SW005			S38SW006	S38SW007
	RPLSW0010001	RPLSW0020001	RPLSW0020001-AVG	RPLSW0020001-D	RPLSW0030001	S38SW0050102	S38SW0050102-AVG	S38SW0050102-D	S38SW0060102	S38SW0070102
	6/27/1997	6/27/1997	6/27/1997	6/27/1997	6/27/1997	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005
Volatile Organics (µg/L)										
CARBON DISULFIDE	5 U	7	4.75	5 U	5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Semivolatile Organics (ug/L)										
DI-N-BUTYL PHTHALATE	12 U	1 J	1 J	11 U	11 U	10 U	10 U	10 U	10 U	10 U
Explosvies (µg/L)										
3-NITROTOLUENE						0.50 U	0.066 J	0.066 J	0.50 U	0.053 J
Inorganics (ug/L)										
BARIUM	22.9	33.6	32.7	31.8	31.2	62.8	61.35	59.9	48.8	41.5
COPPER	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	116 J	68.7 J	42.7 B	12.6 B	41.8 B
IRON						1550 J	1237.5 J	925 J	511 J	468 J
MANGANESE						101	86.9	72.8	62.8	54.3
VANADIUM	0.87	1.1	1.1	1.1	0.70 U	1.2 B	0.86 B	0.52 B	0.40 U	0.40 U
ZINC	7.4	3.9	2.575	2.5 U	9.9	99.6 J	58.05 J	33 B	11.4 B	28.3 B

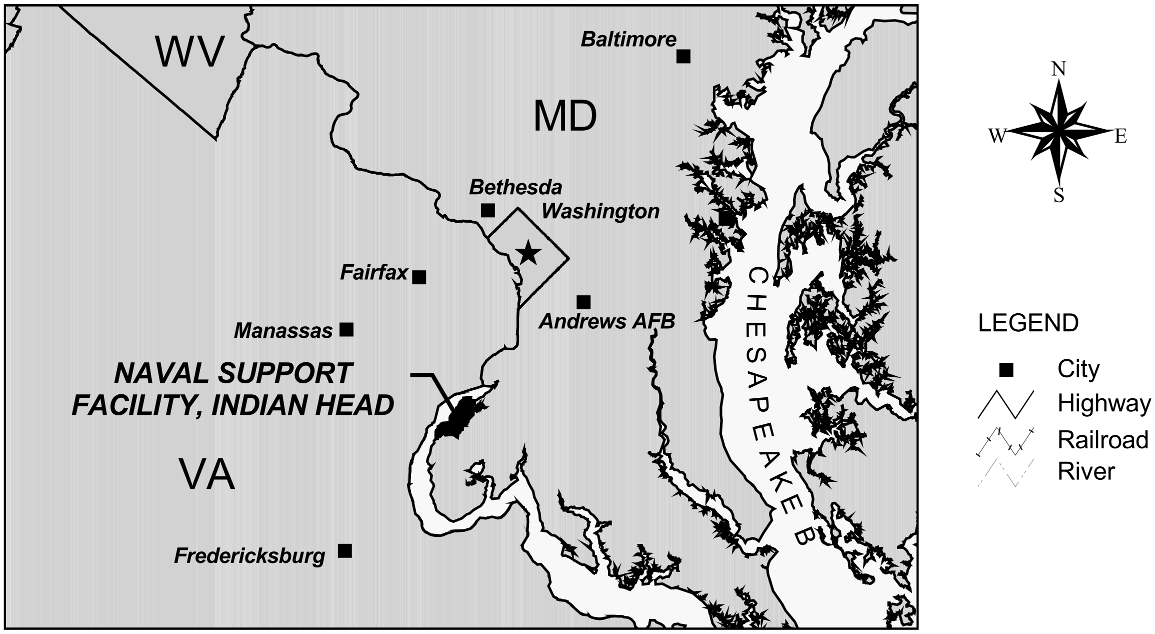
B - Detected in blank; false positive.
J - Estimated.
U - Not detected.

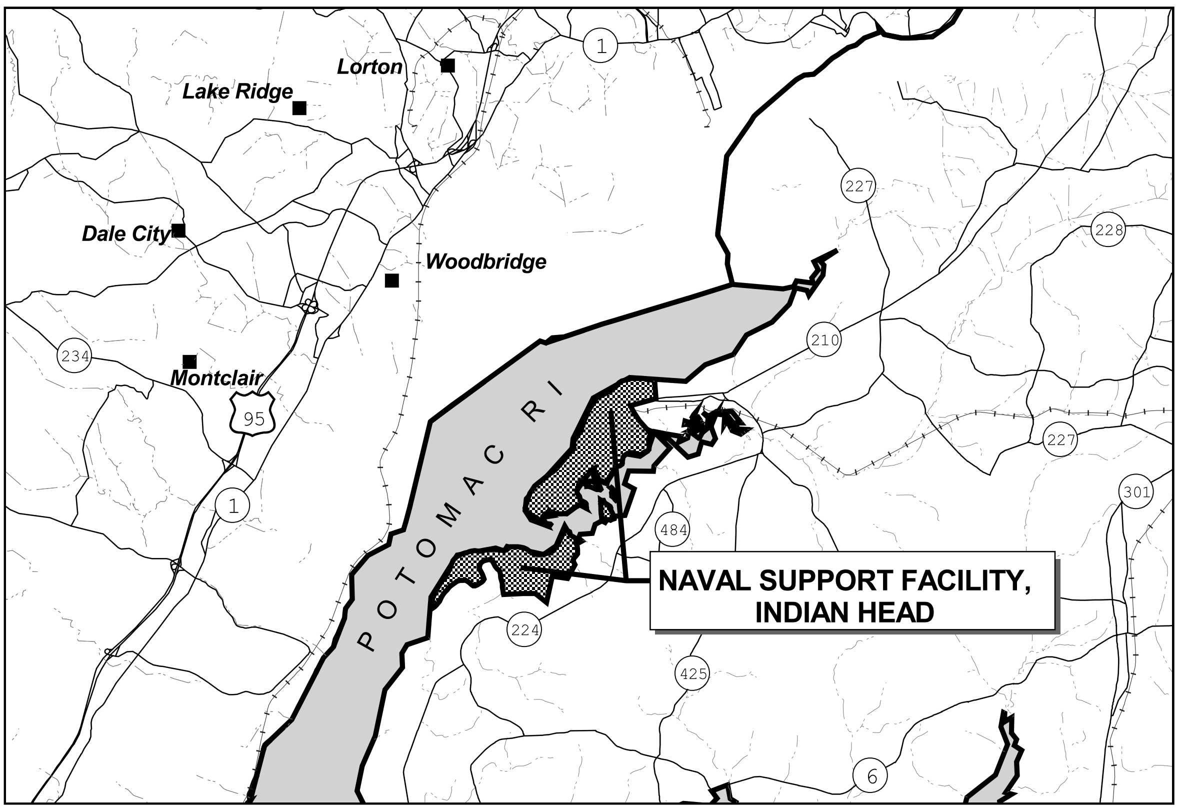
TABLE 1-5

SUMMARY OF DETECTED CONCENTRATIONS - SEDIMENT
SITE 38 - RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

PARAMETER	RPLSD01	RPLSD02			RPLSD03	S38SD004	S38SD005			S38SD006	S38SD007
	RPLSD0010001	RPLSD0020001	RPLSD0020001-AVG	RPLSD0020001-D	RPLSD0030001	S38SD0040102	S38SD0050102	S38SD0050102-AVG	S38SD0050102-D	S38SD0060102	S38SD0070102
	--	--	--	--	--	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
	6/27/1997	6/27/1997	6/27/1997	6/27/1997	6/27/1997	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005	6/22/2005
Volatile Organics (µg/kg)											
CHLOROBENZENE	6 U	6 U	6 U	6 U	6 U	3 J	13 U	1 J	1 J	13 U	13 U
METHYLENE CHLORIDE	2 B	3 B	2.5 B	2 B	3 B	4 J	4 J	3.5 J	3 J	13 U	6 J
TOLUENE	6 U	6 U	6 U	6 U	6 U	3 J	1 J	1 J	13 U	13 U	13 U
TRICHLOROFLUOROMETHANE	6 U	6 U	6 U	6 U	6 U	2 J	13 U	13 U	13 U	13 U	13 U
Semivolatile Organics (µg/kg)											
BENZALDEHYDE						64 J	390 UJ	405 U	420 U	420 U	450 U
BENZO(A)ANTHRACENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	405 U	420 U	420 U	88 J
BENZO(A)PYRENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	405 U	420 U	420 U	150 J
BENZO(B)FLUORANTHENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	44 J	44 J	420 U	190 J
BENZO(G,H,I)PERYLENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	405 U	420 U	420 U	94 J
BENZO(K)FLUORANTHENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	405 U	420 U	420 U	75 J
BIS(2-ETHYLHEXYL)PHTHALATE	430 U	410 U	415 U	420 U	390 U	99 B	63 B	69.5 B	76 B	150 B	730
CHRYSENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	405 U	420 U	420 U	92 J
DI-N-BUTYL PHTHALATE	430 U	410 U	415 U	420 U	390 U	460 U	41 J	42.5 J	44 J	420 U	62 J
DI-N-OCTYL PHTHALATE	430 U	410 U	44 J	44 J	390 U	460 U	390 U	405 U	420 U	420 U	450 U
FLUORANTHENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	79 J	79 J	420 U	450 U
INDENO(1,2,3-CD)PYRENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	405 U	420 U	420 U	94 J
PHENANTHRENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	45 J	45 J	420 U	450 U
PYRENE	430 U	410 U	415 U	420 U	390 U	460 U	390 U	72 J	72 J	420 U	450 U
Explosives (mg/kg)											
3-NITROTOLUENE						0.25 U	0.25 U	0.04 J	0.04 J	0.25 U	0.25 U
4-NITROTOLUENE						0.25 U	0.25 U	0.25 U	0.25 U	0.036 J	0.25 U
NITROCELLULOSE						1.4 J	0.82 J	0.70 J	0.58 J	1 J	0.95 J
Inorganics (mg/kg)											
ALUMINUM						5550	817	1043.5	1270	769	2190
ARSENIC	2.6	0.63 L	0.68 L	0.73 L	0.91 L	2.4 K	1.2	1.6	2	0.96	1.9
BARIUM	13.0 J	4.3 J	4.1 J	3.9 J	5.8 J	58.7	8.4	10.85	13.3	7.5	19.2
BERYLLIUM	0.21	0.08 B	0.10 B	0.12 B	0.16	0.50	0.15	0.19	0.23	0.13	0.31
CADMIUM	0.54	0.23	0.195	0.16	0.28	0.21	0.044	0.048	0.052	0.036 U	0.074
CHROMIUM	15.4 J	5.7 J	5.5	5.3 J	8.3 J	13.1	5.4	12.1	6.7	4.9	9.3
COBALT	0.87	0.41	0.405	0.40	0.44	8	1.1 B	0.925	1.3	0.70 B	1.7
COPPER	2.9	0.71	0.69	0.67	0.75	19.5	3.4 B	3.55 B	3.7 B	2.7 B	4.1 B
IRON						9400	3400	3860	4320	3040	6120
LEAD	5.4	1.6	1.85	2.1	2.8	20.4	2.5	2.9	3.3	2.3	5.4
MANGANESE						85.4	43.6	49.1	54.6	31.3	83
MERCURY	0.03	0.02 U	0.02	0.03	0.02 U	0.056 U	0.05 U	0.053 U	0.056 U	0.053 U	0.054 U
NICKEL	2.6	0.64	0.65	0.66	0.72	10.5 K	1.8 K	2.15 K	2.5 K	1.2 B	3.1 K
SELENIUM	0.96 J	0.43 J	0.275 J	0.24 UJ	0.35 J	0.58 U	0.48 U	0.515 U	0.55 U	0.54 U	0.55 U
VANADIUM	15.7	4.7	4.65	4.6	7.2	18.4	4.5	5.25	6	4.3	8.4
ZINC	11.4	4.5	4.6	4.7	7.0	24.6	12 B	13.65 B	15.3 B	7.9 B	18.2 B

B - Detected in blank; false positive.
J - Estimated.
K - Biased high.
L - Biased low.
U - Not detected.





DRAWN BY K. PEILA	DATE 2/4/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2144	OWNER NO. 005
CHECKED BY G. LATULIPPE	DATE 2/2/04	FACILITY LOCATION MAP NAVAL SUPPORT FACILITY, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 6/4/04
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 1-1	REV 0

P:\GIS\NSWC_INDIAN_HEAD\WORKPLAN_SITELOCATION.APR FACILITY LOCATION MAP 12/12/05 KMP

PGH P:\GIS\INDIANHEAD_NSWC_NEW\MAPDOCS\MXD\SITE38_LOCATION.MXD 12/28/10 TW

DRAWN BY T. WHEATON	DATE 12/28/10	TETRA TECH	CONTRACT NUMBER ___	OWNER NUMBER CTO JU03
CHECKED BY S. NESBIT	DATE 12/28/10	SITE LOCATION MAP SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY ___	DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___	DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 1-2	REV 0

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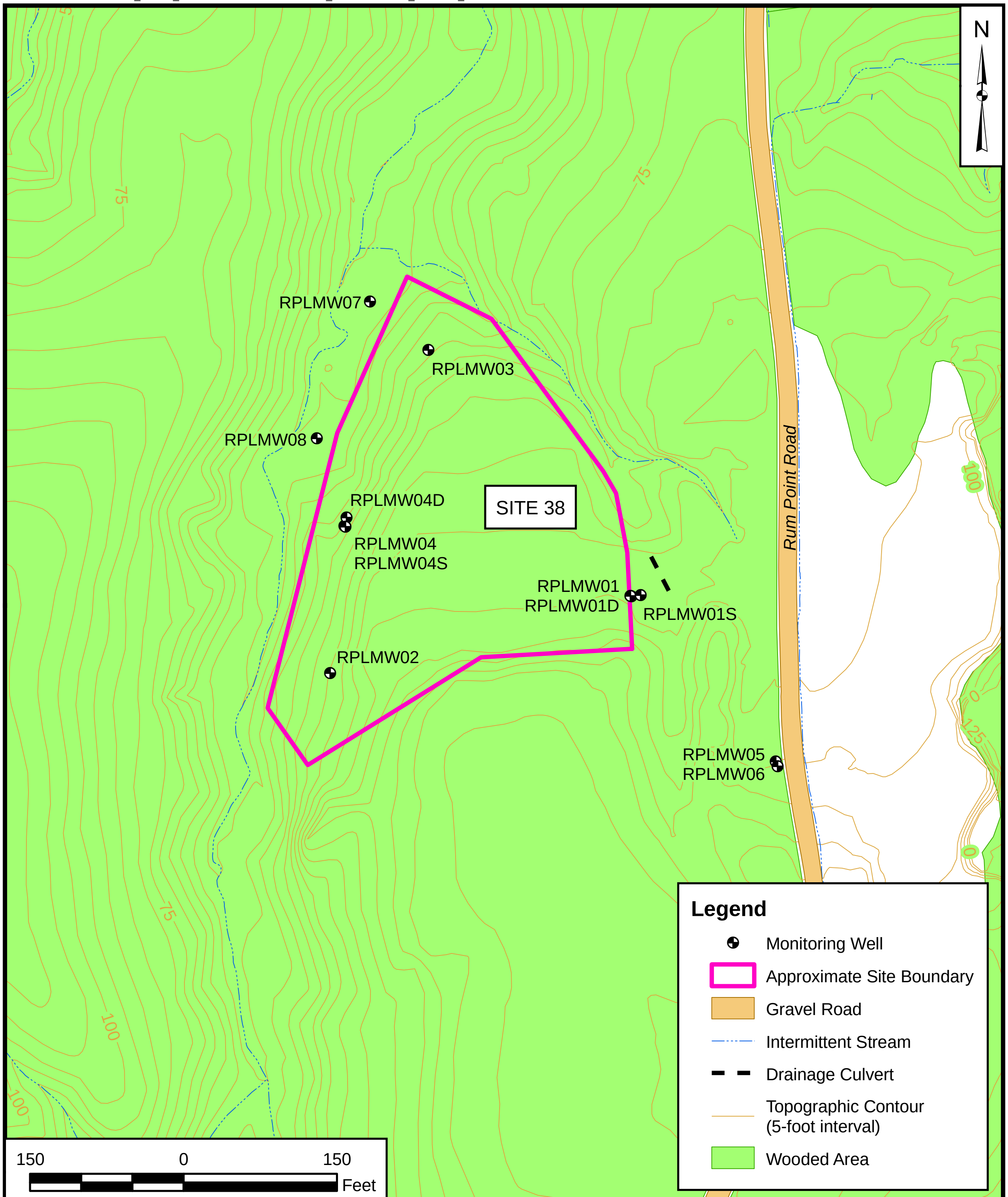

DRAWN BY J. ENGLISH	DATE 09/25/09	TETRA TECH	CONTRACT NUMBER	OWNER NO. CTO JU03
CHECKED BY S. NESBIT	DATE 11/30/10	SITE LOCATION	APPROVED BY	DATE
COST/SCHEDULE AREA		SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD	APPROVED BY	DATE
SCALE AS NOTED		INDIAN HEAD, MARYLAND	DRAWING NO. FIGURE 1-3	REV 0

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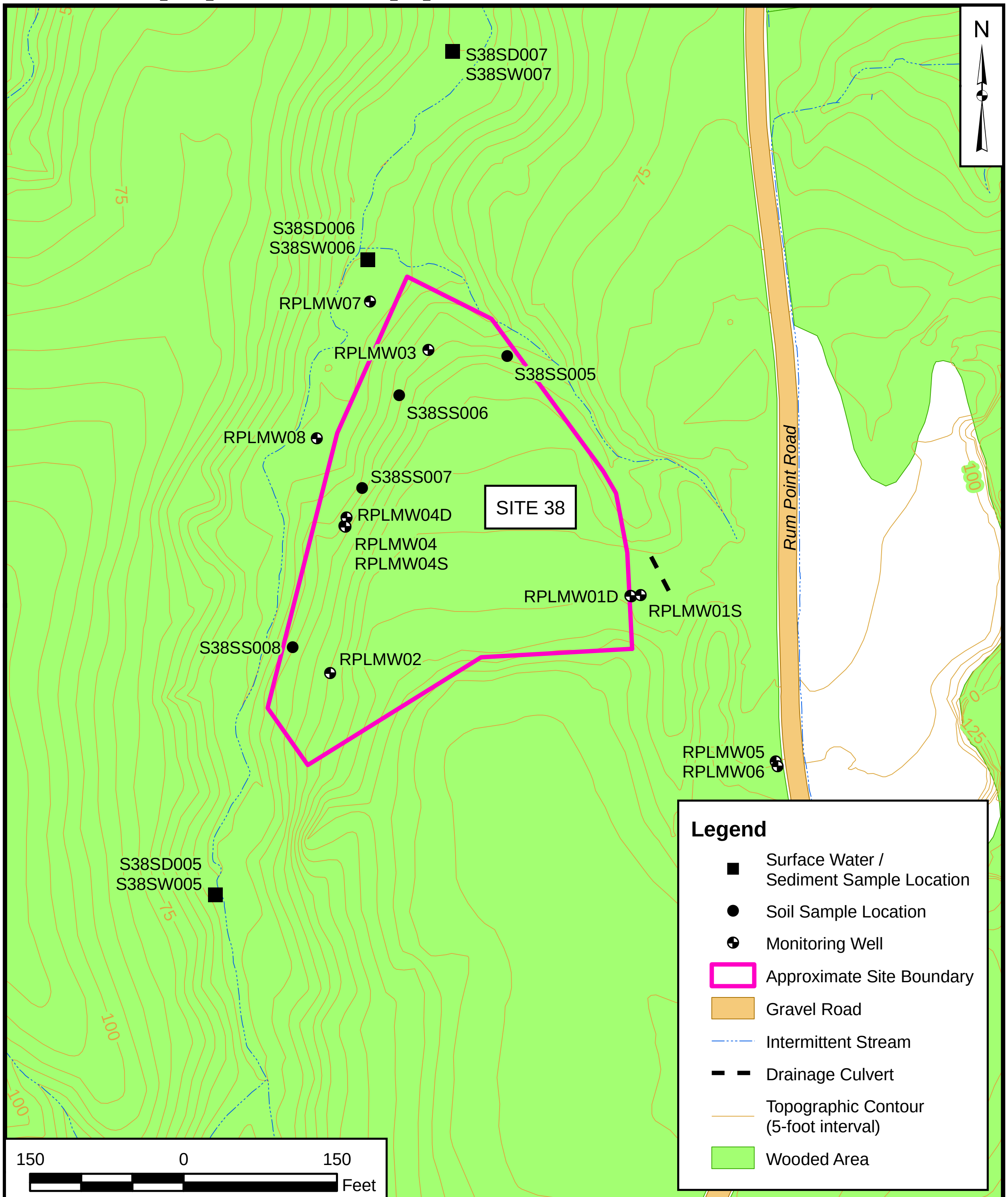
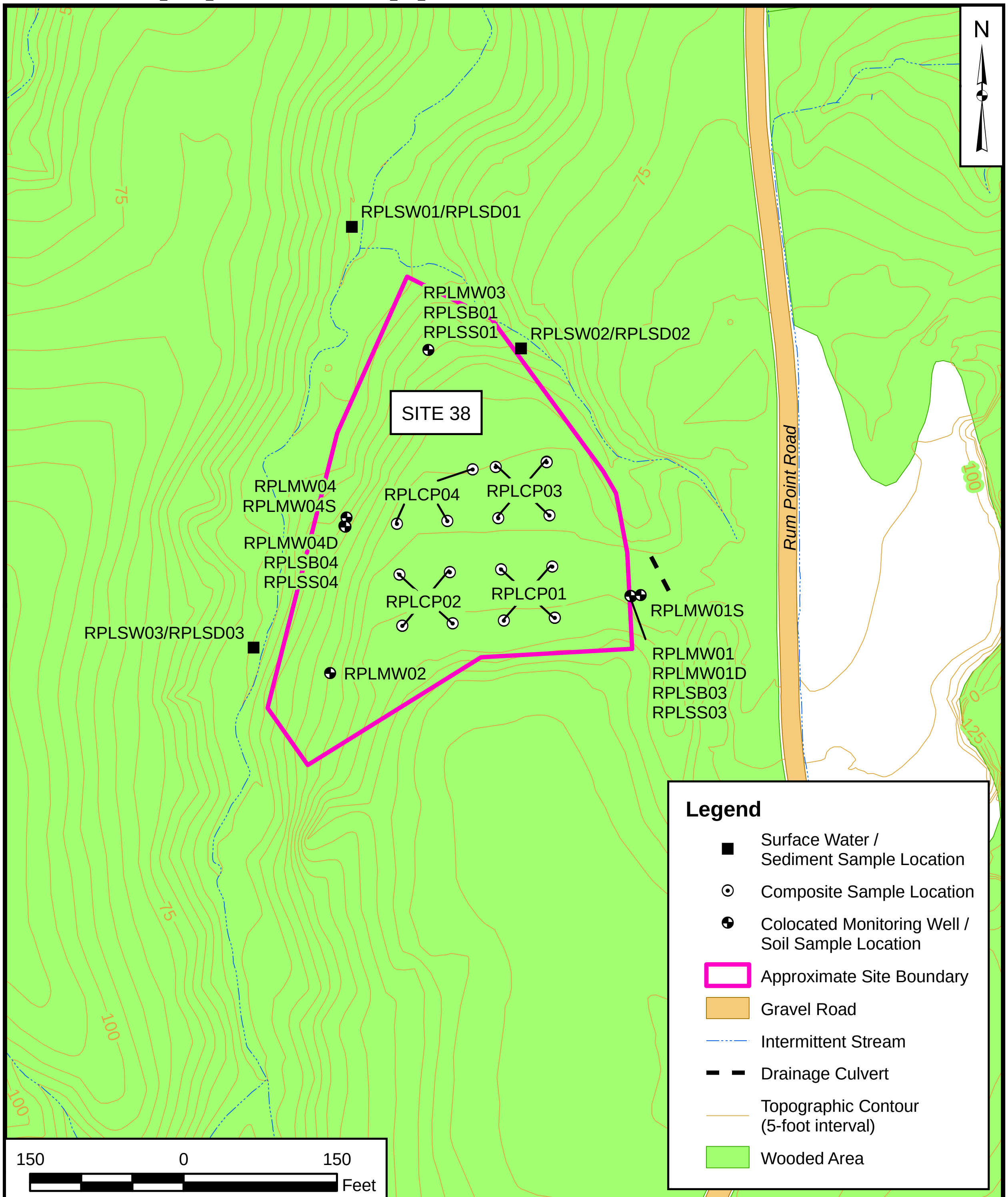


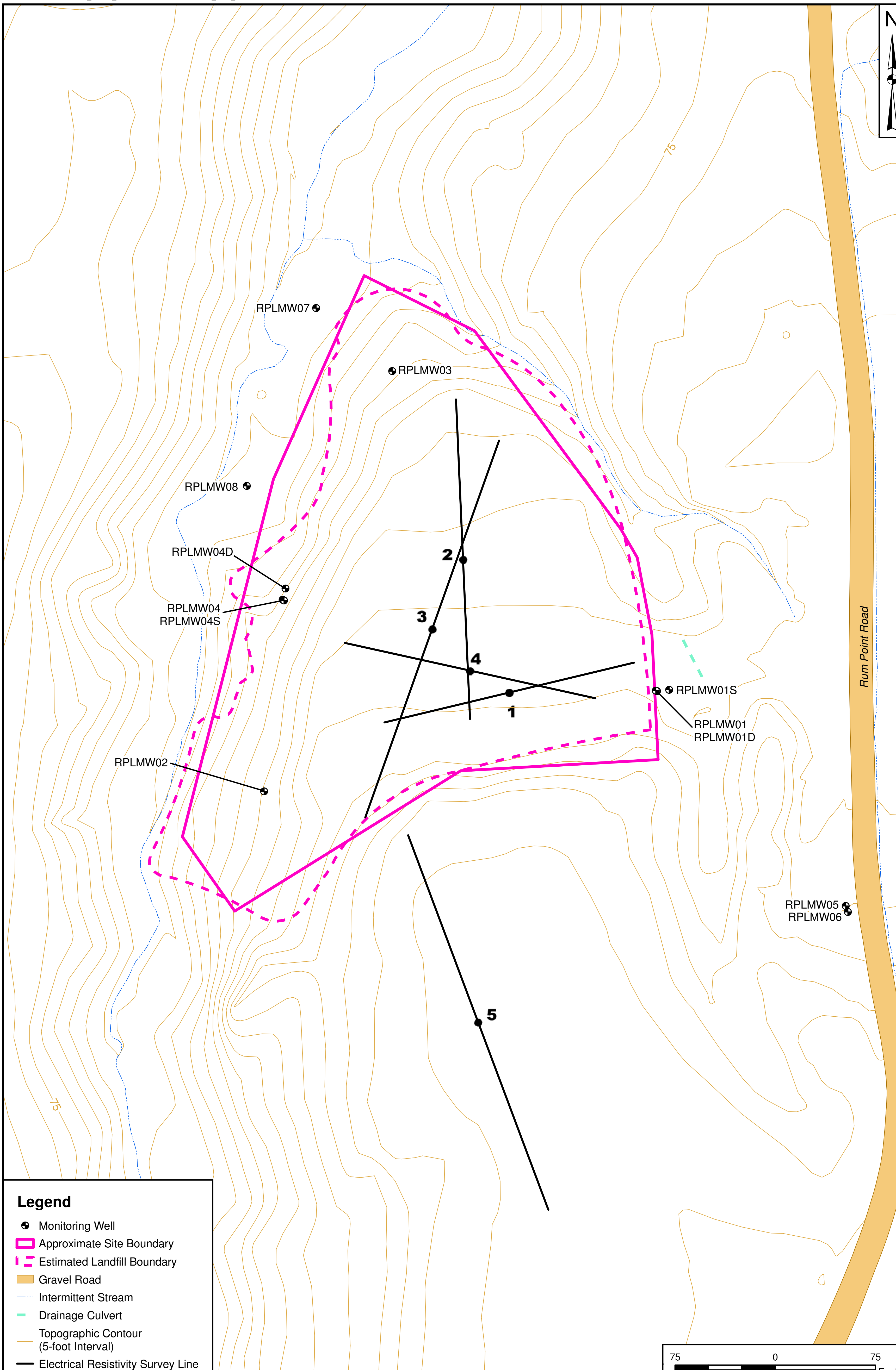
DRAWN BY J. ENGLISH	DATE 11/30/10	TETRA TECH	CONTRACT NUMBER ___	OWNER NO. CTO JU03
CHECKED BY S. NESBIT	DATE 11/30/10	SSP AND EXPANDED SSP SAMPLE LOCATIONS SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY ___	DATE ___
COST/SCHEDULE AREA			APPROVED BY ___	DATE ___
SCALE AS NOTED			DRAWING NO. FIGURE 1-4	REV 0

PGH P:\GIS\INDIANHEAD_NSWC_NEW\MAPDOCS\MXD\SITE38_RFI_SAMPLOCS.MXD 11/30/10 JEE

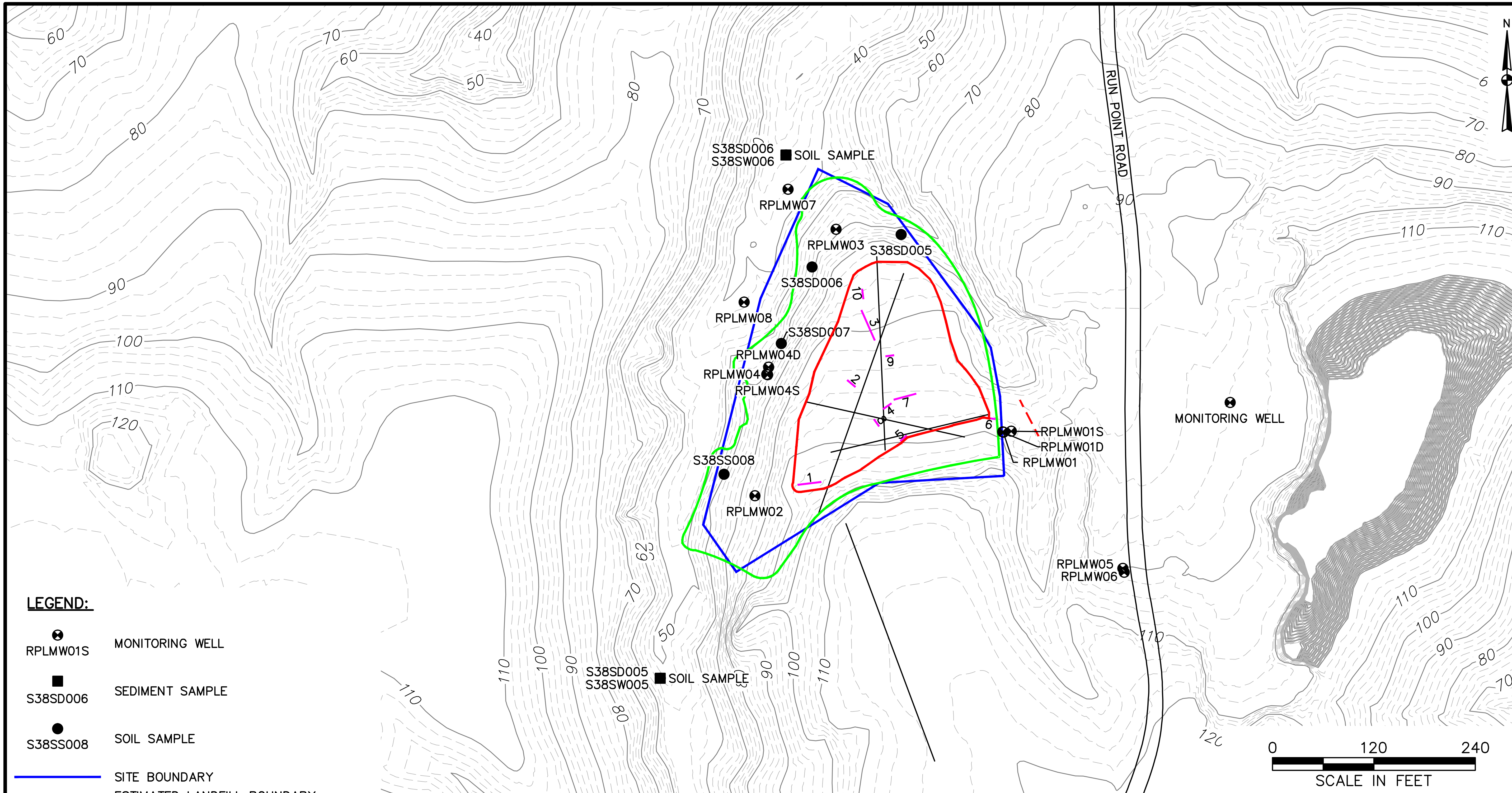


DRAWN BY J. ENGLISH	DATE 11/30/10	TETRA TECH	CONTRACT NUMBER ___	OWNER NO. CTO JU03
CHECKED BY S. NESBIT	DATE 11/30/10	RFI SAMPLE LOCATIONS SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY ___	DATE ___
COST/SCHEDULE AREA			APPROVED BY ___	DATE ___
SCALE AS NOTED			DRAWING NO. FIGURE 1-5	REV 0

PGH P:\GIS\INDIANHEAD_NSWC_NEW\MAPDOCS\MXD\SITE38_SITE_BOUNDARY.MXD 12/27/10 TW



DRAWN BY J. ENGLISH	DATE 11/30/10	TETRA TECH	CONTRACT NUMBER	OWNER NUMBER CTO JU03
CHECKED BY S. NESBIT	DATE 12/27/10	APPROXIMATE SITE BOUNDARY SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY	DATE
REVISED BY T. WHEATON	DATE 12/27/10		APPROVED BY	DATE
SCALE AS NOTED			FIGURE NO. FIGURE 1-6	REV 0



LEGEND:

RPLMW01S	MONITORING WELL
S38SD006	SEDIMENT SAMPLE
S38SS008	SOIL SAMPLE
	SITE BOUNDARY
	ESTIMATED LANDFILL BOUNDARY
	LIMIT OF LANDFILL WASTE
1	TRENCH
	DRAINAGE CULVERT
	ELECTRICAL RESSISTIVITY SURVEY LINE

DRAWN BY	DATE
ND	6/4/12
CHECKED BY	DATE
REVISED BY	DATE
SCALE 1"=120'	

NAVFAC

MAY 2012
TEST TRENCH LOCATIONS
SITE 38
NSF INDIAN HEAD
INDIAN HEAD, MARYLAND

CONTRACT NO. 2050

OWNER NO.

APPROVED BY DATE

DRAWING NO. FIGURE 1–7 SIZE B REV. 0

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2.0 REMEDIAL ACTION OBJECTIVES

2.1 INTRODUCTION

This section presents the objectives for remedial action and the factors used to develop remedial alternatives for Site 38. These factors are the PRGs (clean-up goals) and regulatory requirements and guidance [applicable or relevant and appropriate requirements (ARARs)] that may potentially govern the remedial action. In addition, this section presents the COCs and conceptual pathways through which these chemicals may adversely affect human health and the environment. The cleanup goals for contaminated media are also developed in this section, and general response actions (GRAs) that may be suitable to achieve the cleanup goals are presented. Finally, this section presents estimates of the volumes of contaminated soil and groundwater.

2.2 MEDIA OF INTEREST

In the SSP Report (Tetra Tech, 2008), the data available for Site 38 were evaluated, and human health and ecological risk screening evaluations were conducted. Based on the recommendations from the SSP Report, an evaluation of ARARs, and anticipated future uses of the site, the media of interest are soil, landfill waste, and groundwater. Unacceptable human health risks were identified from exposure to shallow groundwater and soil under a hypothetical future residential exposure scenario; however groundwater contamination is only present beneath the limits of the landfill. There is also inherent risk from exposure to landfill waste at the site.

Shallow groundwater beneath the landfill is not within the area of attainment, as defined by EPA (OSWER Directive 9283.1-33), and adjacent surface water is not being adversely affected by the discharge of shallow groundwater. The area of attainment defines the area over which groundwater clean-up levels must be met. It encompasses the area outside the waste boundary and within the boundary of the contaminant plume. Groundwater beneath the waste management boundary is not within the area of attainment (Figure 2-1); however, remediation of shallow groundwater will be evaluated in this FS to facilitate development of a clean closure alternative.

2.3 REMEDIAL ACTION OBJECTIVES

Based on current and potential future land use scenarios, the remedial action objectives (RAOs) for Site 38 are:

- Close the landfill in a manner that protects human health and the environment in accordance with the applicable and relevant State of Maryland solid waste management regulations.
- Return groundwater to beneficial reuse to the extent practicable.

These RAOs were developed following guidance provided in Land Use in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedy Selection Process (EPA, 1995). According to this guidance, RAOs should reflect the reasonably anticipated future land use or uses of the site.

2.4 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

One of the primary concerns during the development of remedial action alternatives under CERCLA is the degree of human health and environmental protection afforded by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that meet or exceed ARARs. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental regulations. On-site actions need only comply with substantive requirements (e.g., design standards). Off-site actions must comply with substantive and administrative (e.g., permits, recordkeeping) requirements. The term “on site” means the areal extent of contamination and all suitable areas in proximity to the contamination necessary for implementation of the response action.

ARARs consist of the following:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility siting law that is more stringent than the associated federal standard, requirement, citation, or limitation.

Definitions of the two types of ARARs and to be considered (TBC) criteria are:

- Applicable requirements include those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that directly and fully address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site.

- Relevant and appropriate requirements include those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, although not applicable, address problems or situations sufficiently similar (relevant) to those encountered at the CERCLA site that their use is well suited (appropriate) to the particular site.

- TBC criteria are non-promulgated non-enforceable guidelines or criteria that may be useful for developing remedial action alternatives and for determining action levels that are protective of human health and the environment.

Section 121(d)(4) of CERCLA allows the selection of a remedial alternative that will not attain an ARAR if any of six conditions for a waiver of an ARAR exist. These conditions are as follows: the remedial action is an interim measure and the final remedy will attain the ARAR at completion; compliance will result in greater risk to human health and the environment than other options; compliance is technically impracticable; an alternative remedial action will attain the equivalent of the ARAR; for state requirements, the state has not consistently applied the requirement in similar circumstances; and compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of funds. The last condition only applies to Superfund-financed actions.

As discussed below, ARARs are divided into three categories, chemical, location, and action specific, based on the manner in which they are applied. Some requirements are combinations of the three types of ARARs.

2.4.1 Chemical-Specific

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Chemical-specific ARARs govern the extent of site cleanup and provide medium-specific guidance on acceptable or permissible concentrations of contaminants. These ARARs and TBCs provide some medium-specific guidance on “acceptable” or “permissible” concentrations of contaminants. Table 2-1 presents a list of federal chemical-specific ARARs and TBCs for this FS.

2.4.2 Location-Specific

Location-specific ARARs are restrictions based on the concentrations of hazardous substances or the conduct of activities in specific locations. Some examples of specific locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. These ARARs may restrict or preclude certain remedial actions and may apply only to certain portions of the site. Table 2-2 presents a summary of location-specific ARARs and TBC criteria for Site 38.

2.4.3 Action-Specific

Action-specific ARARs are technology- or activity-based controls or restrictions on activities related to management of hazardous substances. Action-specific ARARs pertain to implementing a given remedy. Table 2-3 presents a summary of action-specific ARARs and TBC criteria for Site 38.

2.5 CHEMICALS OF CONCERN FOR REMEDIATION

COCs for Site 38 were established based on a human health risk assessment that employed USEPA guidelines for risk characterization. The HHRA determined that there are potentially unacceptable risks to human health associated with exposure to site soil and groundwater under a residential exposure scenario. There are no unacceptable risks to human health associated with exposure to surface water or sediment. The results of the assessment are provided in the SSP (Tetra Tech, 2008).

The primary carcinogenic risk drivers for soil are benzo(a)pyrene and arsenic. The primary non-carcinogenic risk driver for soil is arsenic, and the primary non-carcinogenic risk driver for groundwater is manganese.

2.6 CLEAN-UP GOALS

A clean-up goal is the target concentration to which a COC must be reduced within a particular medium of concern to achieve RAOs. The clean-up goals are developed based on readily available information such as chemical-specific ARARs.

2.6.1 Soil Cleanup Goals

Site 38 is an inactive landfill located on Navy property that is expected to be used for commercial/industrial purposes for the foreseeable future. As such, construction of a landfill covers system combined with LUCs would mitigate potential risks associated with exposure to contaminated soil and landfill waste. Under this scenario, the development of cleanup goals for soil and waste is not required.

However, based on the relatively small size of Site 38, a removal alternative is being developed in this FS for comparison with the capping alternative. With this alternative, waste and visibly contaminated soil would be excavated and disposed of offsite. Following the removal activities, soil samples would be collected to characterize post-excavation conditions and to evaluate whether residual contamination is present. Given the heterogeneous nature of the landfill waste, contaminant-specific cleanup criteria cannot be developed prior to post-excavation sampling. Under this alternative, post-excavation sampling data would be compared with applicable screening criteria, and human health and ecological risks would be calculated to determine whether additional excavation is required. Excavation would then continue until the site was determined to be suitable for unrestricted use.

2.6.2 Groundwater Cleanup Goals

Manganese was identified as the primary risk driver in groundwater at Site 38. The two greatest manganese concentrations were detected in samples from monitoring wells MW01S [2,250 microgram per liter (µg/L), located along the southeastern edge of the landfill] and MW05 (1,550 µg/L, located approximately 180 feet from the southeastern edge of the landfill). Based on water level data, groundwater flow direction across the landfill is to the northwest, thus MW05 is located upgradient of the landfill, and MW01S is located along the upgradient edge of the landfill (Figure 2-1). Based on this, it is questionable whether the manganese found in these wells is site related.

Along the downgradient (northwestern) edge of the landfill, monitoring well MW07 had a manganese concentration (593 µg/L) greater than the risk-based screening level (RSL) (320 µg/L). The remaining monitoring wells located within and downgradient of the landfill footprint had manganese concentrations less than the RSL.

Elevated manganese levels in groundwater are commonly associated with landfills because the geochemical conditions typically associated with landfills promote reducing conditions, which in turn reduce manganese oxide present on aquifer sediments (Mn+4) to a more soluble form (Mn+2). Streambed sediments in particular often have manganese oxide coatings, and MW07 is located adjacent to a small stream in sand/gravel sediments. In addition, the common landfill gas methane is associated with reducing conditions and related manganese dissolution.

Oxidation-reduction potential (ORP) is an indication of whether reducing conditions are present in groundwater, with low to negative readings indicating reducing conditions. At Site 38, the three wells with the greatest manganese concentrations had three of the four lowest ORP readings (all negative), as shown in the Table 2-4, indicating a correlation between dissolved manganese and reducing conditions. After excavation and removal of the landfill under the clean closure alternative, it is expected that groundwater geochemical conditions would revert back to normal within a reasonable time frame, i.e., the reducing conditions would revert back to a more oxidized state. This would have the effect of decreasing manganese solubility and dissolved manganese concentrations in groundwater.

A monitoring program would be developed at the time of landfill removal to characterize groundwater conditions near and within the limits of the waste. The monitoring program would characterize the groundwater and be used to evaluate the natural attenuation of manganese contamination following landfill removal. The program would also identify an exit strategy based on achieving an acceptable human health risk level, at which time the site would be deemed suitable for unrestricted use and any LUCs associated with the site could be withdrawn.

2.7 VOLUME OR AREA OF CONTAMINATED MEDIA

For remedial action purposes, preliminary volumes of contaminated media were estimated from samples that contained contaminants at concentration levels that exceeded clean-up goals for residential land use.

Based on the investigations conducted to date (geophysical surveying, soil boring and soil sampling), the landfill covers an area of approximately 37,000 square feet (0.85 acre), and the depth of fill ranges from 1 to 7 feet. Assuming an average depth of 3 feet, the estimated landfill volume is 4,100 cubic yards.

Based on SSP analytical results, contaminated groundwater was identified at the site. The Site 38 manganese plume is defined as the area of groundwater where concentrations of manganese are greater than the RSL of 320 µg/L. The groundwater contamination extends over an area approximately 190,350 square feet to a depth of up to 30 feet bgs. Based on a water table elevation of 15 feet bgs and a porosity of 0.30, the estimated volume of contaminated groundwater at Site 38 is 6.4 million gallons. The extent of the groundwater contamination at Site 38 is illustrated on Figure 2-1.

TABLE 2-1

CHEMCIAL-SPECIFIC ARARs AND TBC CRITERIA
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Federal					
Groundwater, Residential water supplies	Groundwater manganese concentrations must meet non-carcinogenic risk-based limits based on a hazardous index of 1.	Potential drinking water source.	USEPA Integrated Risk Information System Reference Dose (RfD)	To be considered.	RfDs are used to calculate risk and PRG for manganese.

ARARs Applicable or relevant and appropriate requirement.

TABLE 2-2

LOCATION-SPECIFIC ARARs AND TBC CRITERIA
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Federal					
United States Fish and Wildlife Service (USFWS) Biological Opinion, 2007					
Habitat for Bald and Golden Eagle	The Navy will take the appropriate measures to minimize impacts to Bald Eagles including time-of-year restrictions for construction activities.	Actions that will impact Bald Eagle habitat.	USFWS Biological Opinion, letter to Mr. Jeffrey Bossart, August 2007	Selected Performance Standard	Construction activities will be limited to a time of year that will not impact Bald Eagle nesting.
Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act and Executive Order 11990, Protection of Wetlands					
Wetlands	Action to minimize the destruction, loss, or degradation of wetlands. Wetlands of primary ecological significance must not be altered so that ecological systems in the wetlands are unreasonably disturbed.	Wetlands as defined by Executive Order 11990 Section 7	Executive Order 11990 Section 7	To be considered.	This regulation may be an ARAR for activities occurring in areas that meet the definition of a wetland. Due to the proximity of the streams and the presence of plant life associated with a nontidal wetland remedial activities must minimize the destruction, loss, or degradation of the wetlands.

TABLE 2-2

LOCATION-SPECIFIC ARARs AND TBC CRITERIA
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

Location	**Requirement**	**Prerequisite**	**Citation**	**ARAR Determination**	**Comments**
Clean Water Act, Section 404					
Wetlands	The degradation Section requires degradation or destruction of wetlands and other aquatic sites be avoided to the extent possible. Dredged or fill material must not be discharged to navigable waters if the activity: contributes to the violation of Maryland water quality standards; CWA Sec. 307; jeopardizes endangered or threatened species; or violates requirements of the Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 230.10; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Applicable	This regulation may be an ARAR for activities occurring in areas that meet the definition of a wetland. Due to the proximity of the streams and the presence of plant life associated with a nontidal wetland remedial activities must minimize the destruction, loss, or degradation of the wetlands.
Fish and Wildlife Coordination Act					
Area affecting stream or other water body	Provides protection for actions that would affect streams, wetlands, other bodies of water, and protected habitats. Any action taken near water bodies should protect fish and wildlife.	Activities that modify the streams and affect fish and wildlife.	16 USC Part 661 et seq.	Applicable	The rule may be an ARAR if excavation or cover placement activities impact the streams that border the site.

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
State					
Nontidal Wetlands Protection Act					
Area affecting non-tidal wetlands	Provides regulations for activities on or near nontidal wetlands (an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions). Must obtain a permit from the State in order to conduct certain regulated activities in a nontidal wetland, or within a buffer or an expanded buffer.	Activities that will occur on or near nontidal wetlands.	COMAR 26.23.02.01, 26.23.02.04, 26.23.03.01-02	Applicable	This regulation may be an ARAR for activities occurring in areas that meet the definition of a wetland. Due to the proximity of the streams and the presence of plant life associated with a nontidal wetland remedial activities must minimize the destruction, loss, or degradation of the wetlands.

ARARs Applicable or relevant and appropriate requirement.

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Federal					
Hazardous Waste Management					
On-site waste generation	Waste generator to determine whether waste is hazardous waste.	Generation (e.g., excavation) of solid waste.	40 CFR 262.10(a) and 262.11	Applicable	Material to be transported off site would need to be tested to determine whether it is a hazardous waste.
Generation of hazardous waste	Manifest requirements and pre-transport requirements (i.e., packaging, labeling, placarding).	Preparation for off-site transport of hazardous waste.	40 CFR 262 Subpart B and C	Applicable	Applicable only for off-site shipment of hazardous waste.
Staging of hazardous waste within an AOC prior to off-site disposal	The Area of Contamination (AOC) policy allows wastes to be consolidated or treated in-situ within an AOC without triggering land disposal restrictions or minimum technology requirements. An AOC would be defined for the entire site so that contaminated material can be stockpiled prior to characterization and off-site disposal.	Landfill material that is classified as hazardous waste will be consolidated on-site prior to off-site disposal.	Management of Remediation Waste Under RCRA - Area of Contamination Policy, EPA 530-F-98-026, October 1998	To be considered.	Pertinent only for waste that is classified as hazardous waste.

TABLE 2-3

ACTION-SPECIFIC ARARs AND TBC CRITERIA
SITE 38 – RUM POINT LANDFILL
NSV-IH, INDIAN HEAD, MARYLAND

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Solid Waste Management					
On-site disposal of non-hazardous waste	Closure and post-closure care requirements for municipal waste landfills, including final cover system, inspection, maintenance, and monitoring.	On-site disposal of municipal solid waste.	40 CFR 258.60(a), 258,60(b), 258.61(a), and 258.61(b)	Applicable	Applicable for on-site disposal of non-hazardous waste. Only constituents identified as COCs in groundwater would be included in the groundwater monitoring program.
Clean Water Act					
Discharge to surface water	NPDES permit requirements.	Discharge of storm water from construction activity with an area of disturbance of 1 acre or more to surface water.	40 CFR 122.26	Applicable	Applicable for alternatives that will need to control and manage storm water during construction.
State					
Hazardous Waste Management					
On-site waste generation	Waste generator to determine whether waste is hazardous waste.	Generation (e.g., excavation) of solid waste.	COMAR 26.13.03.02	Applicable	Material to be transported off site would need to be tested to determine whether it is a hazardous waste.
Generation of hazardous waste	Manifest requirements and pre-transport requirements (i.e., packaging, labeling, and placarding).	Temporary storage and off-site transport of hazardous waste.	COMAR 26.13.03.04 and 26.13.03.05	Applicable	Applicable only for off-site shipment of hazardous waste.

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Solid Waste Management					
Closure of solid waste landfill	Closure and post-closure care requirements for non-hazardous waste landfills, including capping, inspection, maintenance, and monitoring.	Landfill not closed in accordance with state regulations.	COMAR 26.04.07.21 and 26.04.07.22	Applicable	Applicable for design of soil cover, impermeable capping systems, and long-term monitoring program.
Water Management					
Discharge to surface water	NPDES permit requirements – storm water associated with construction activity..	Discharge of storm water from construction activity with area of disturbance of 1 acre or more to surface water.	COMAR 26.08.04.09	Applicable	Applicable for alternatives that disturb 1 or more acre of land that will need to control and manage storm water during construction. Activities must meet the substantive requirements of a General Permit for Construction Activity.
Discharge to surface water	NPDES permit requirements	Discharge of storm water from construction activity in contaminated area.	COMAR 26.08.02.02-1 26.08.02.03 26.08.02.03-1 26.08.02.03-2 26.08.02.03-3 26.08.02.03-4 26.08.02.04-1 26.08.02.05 26.08.02.09 26.08.03	Applicable	Applicable for alternatives that disturb 1 or more acre of land that will need to control and manage storm water during construction that may contain contaminants not found in typical construction activities and where general permit is not sufficient..

ACTION-SPECIFIC ARARs AND TBC CRITERIA
SITE 38 – RUM POINT LANDFILL
NSV-IH, INDIAN HEAD, MARYLAND

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Land-disturbing activities	Requirements for erosion and sediment control.	Land clearing, grading, and other earth disturbance.	COMAR 26.17.01.05, 26.17.01.07B, 26.17.01.07C, 26.17.01.11.	Applicable	Applicable for alternatives that will disturb earth.
Land development	Requirements for storm water management.	Construction activities.	COMAR 26.17.02.06, 26.17.02.08, 26.17.02.09	Applicable	Applicable for alternatives where storm water management and control are needed.
Air Quality					
Air emissions	Emission standards for particulate matter.	Soil excavation and handling.	COMAR 26.11.06.03D	Applicable	Applicable for alternatives where there may be fugitive dust emissions from material handling.
Monitoring Wells					
Well construction and abandonment	Requirements for constructing and abandoning wells.	Groundwater monitoring.	COMAR 26.04.04.03, 26.04.04.04, 26.04.04.07, 26.04.04.08, 26.04.04.10, 26.04.04.11.	Applicable	Applicable for alternatives that include construction of new monitoring wells or abandoning existing monitoring wells.
Occupational, Industrial, and Residential Hazards					
Noise generation	Established limits on noise levels not to be exceeded at the property boundary.	Action that will generate noise.	COMAR 26.02.03.02A(2), 26.02.03.02B(2), and 26.02.03.03A	Applicable	Applicable for alternatives that will generate noise.

TABLE 2-3

ACTION-SPECIFIC ARARs AND TBC CRITERIA
SITE 38 – RUM POINT LANDFILL
NSV-IH, INDIAN HEAD, MARYLAND

ARARs	Applicable or relevant and appropriate requirements.
CFR	Code of Federal Regulations.
COMAR	Code of Maryland Regulations.
NPDES	National Pollutant Discharge Elimination System.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

3.1 INTRODUCTION

Identification, screening, and evaluation of potentially applicable technologies and process options are important steps in the FS process. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options that can be combined into remedial alternatives. The basis for technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Development of the RAOs
- Identification of ARARs
- Development of cleanup goals
- Identification of the volume and area of interest

Technology screening is completed and technology evaluation is performed in this section with the following steps:

- Identification of GRAs
- Identification and screening of remedial technologies and process options
- Evaluation of technologies and selection of representative process options

3.2 GENERAL RESPONSE ACTIONS FOR SOIL

GRAs describe categories of actions that could be implemented to satisfy or address a component of an RAO for a site. Typically, the formation of remedial alternatives includes combining GRAs to fully address RAOs. When implemented, the combined GRAs are capable of achieving the RAOs that have been developed for each medium of interest at the site. As discussed in Section 2.0, the media of concern for Site 38 is landfill waste, surface soil, and groundwater.

The following GRAs will be considered for soil and groundwater at Site 38:

- No Action
- Institutional Actions
- Containment
- Removal

* Treatment
* Disposal

3.2.1 No Action

The no action response is retained through the FS process as required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The no action response provides a comparative baseline against which other alternatives can be evaluated. Under this response, no remedial action is taken. The site is left “as is” without the implementation of any monitoring, land use controls (LUCs), containment, removal, treatment, or other mitigating actions.

3.2.2 Institutional Actions

Institutional actions include various site access controls or land use restrictions to reduce or eliminate direct contact pathways of exposure. These controls could involve the use of monitoring, groundwater and land use restrictions, and access controls. The toxicity, mobility, and volume of the waste or contaminants are not reduced through the implementation of LUCs.

3.2.3 Containment

Another method of reducing risk to human health and the environment is through containment, which involves the use of physical measures to reduce the potential for exposure and the potential for contaminant migration. To reduce the migration of contaminants, the contaminated media must be isolated from the primary transport mechanisms such as wind, erosion, surface water, and groundwater. For example, installing surface or subsurface barriers can be used to isolate contaminated media.

3.2.4 Removal

Technologies in this category are used to remove a contaminated medium from its current location to be treated or disposed of elsewhere. Removal actions are combined with treatment and/or disposal actions.

3.2.5 Treatment

Technologies in this category include in-situ and ex-situ methods to remove, modify, or bind a contaminant associated with an impacted medium. These methods typically reduce the overall toxicity, mobility, and/or volume of the impacted medium.

3.2.6 Disposal

Disposal actions include placement of removed and/or treated materials at an on-site or off-site permanent disposal facility. Disposal also includes on-site consolidation of contaminated materials. Disposal actions are combined with removal and/or treatment actions. The toxicity, mobility, or volume of contaminants is not reduced through the singular act of disposal.

3.3 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL

In this section, a variety of technologies and process options were identified under each GRA and screened. The screening was first conducted at a preliminary level to focus on relevant technologies and process options based on site conditions and contaminants and the media of concern. The screening was then conducted on a more detailed level in Section 3.4 based on certain evaluation criteria. Finally, process options were selected to represent technologies that passed the detailed evaluation and screening.

Table 3-1 summarizes the preliminary screening of technologies and process options. It lists the GRA, identifies the technologies and process options, and provides a brief description of the process options and screening comments. All technologies and process options that were not eliminated are evaluated in greater detail in Section 3.4.

3.4 EVALUATION OF TECHNOLOGIES AND SELECTION OF REPRESENTATIVE PROCESS OPTIONS

3.4.1 Evaluation Criteria

The evaluation criteria for detailed screening of technologies and process options retained after the preliminary screening in Section 3.3 were effectiveness, implementability, and cost. The following are descriptions of the evaluation criteria:

- Effectiveness: Protection of human health and the environment; reduction in toxicity, mobility, or volume; permanence of the solution; ability to address the estimated areas or volumes of contaminated media; ability to meet the remediation goals identified in the RAOs; and technical reliability (innovative versus well proven) with respect to contaminants and site conditions.

- Implementability: Overall technical feasibility at a site; availability of vendors, equipment, storage and disposal services, etc.; administrative feasibility; and special long-term maintenance and operation requirements.

- Cost: Capital cost and operation and maintenance (O&M) costs.

All of the factors listed above may not directly apply to each technology and were only addressed as appropriate. Screening evaluations generally focus on effectiveness and implementability, with less emphasis on cost evaluations. Technologies whose use would be precluded by waste characteristics and inapplicability under site conditions were eliminated from further consideration. At this stage, no technologies were eliminated based solely on cost. A process option within a technology category, however, may not have been carried through if an equally effective process option was available at lower cost.

3.4.2 Evaluation of Technologies and Process Options

The final screening of technologies and process options was based on the evaluation criteria presented in Section 3.4.1. The following table presents the technologies and process options remaining for final screening.

General Response Action	Technology	Process Options
No Action	None	None
Institutional Actions	Monitoring	Groundwater and Surface Water Monitoring
	Access/Use Restrictions	Physical Barriers
	LUCs	Groundwater and Land Use Restrictions
Containment	Capping	Multimedia Cap
	Erosion Control	Vegetation
Removal	Excavation	Excavation
Disposal	Landfilling	Hazardous or Non-Hazardous Waste Landfill
		On-Site Consolidation

3.4.2.1 No Action

No action consists of implementing no activities to address contamination. No action was retained as required by the NCP but no evaluation was conducted.

3.4.2.2 Institutional Actions

Institutional actions retained after the initial screening were groundwater and surface water monitoring, physical barriers, and groundwater and land use restrictions. Monitoring may include collection of groundwater and surface water samples followed by analysis for target contaminants. Access restrictions (e.g., fences, warning signs) can be used to prevent or minimize the potential for human contact with contaminants. Identifying restrictions in the Geographic Information System (GIS) maintained by NSF-IH can be used to prevent future land and groundwater uses that could pose risks to human health.

<u>Effectiveness</u>

Access, land use, and groundwater use restrictions can be effective, depending on the administration of the controls. Monitoring is not effective in controlling risks to human health or the environment, but it can determine the effectiveness of a remedial action or the need for additional remedial action.

<u>Implementability</u>

Access, land use, and groundwater use restrictions and monitoring are readily implementable.

<u>Cost</u>

Costs of access, land use, and groundwater restrictions are low. Costs associated with sampling and analysis are low to moderate depending on the nature of the monitoring program.

<u>Conclusion</u>

Access restrictions (e.g., fence, warning signs) were eliminated because there are no short term risks to human health from exposure to surface soil.

Land and groundwater use restrictions and monitoring were retained for further consideration.

3.4.2.3 Containment

The technologies considered under containment were capping and erosion controls, as discussed below.

Multimedia caps (engineered caps) consist of layers of soil, geosynthetic materials, or geocomposite materials placed over landfill wastes. A cap can minimize the potential for direct contact with waste and can reduce the migration of contaminants caused by surface water infiltration, runoff, and wind erosion.

Erosion controls consist of vegetation or riprap placed on the cap to minimize contaminant migration via surface runoff or to protect a cap from erosion.

Effectiveness

A multimedia cap can effectively minimize direct contact with surface contaminants and reduce migration of contamination by surface water infiltration, runoff, and wind erosion.

Erosion controls can be effective for diversion of surface water flow away from the disposal area and for control of runoff from the disposal area.

Implementability

The main concern with implementation of multimedia caps and erosion controls is maintaining integrity from natural and human interferences (e.g., flooding, settlement, unauthorized excavation). Human interferences can be minimized at Site 38 because the site will continue to be part of a federal facility.

Cost

Costs for engineered caps are moderate and costs for erosion controls are low.

Conclusion

Engineered caps were retained as an effective means of minimizing exposure, and erosion controls were retained if needed to protect a cap.

3.4.2.4 Removal

Excavation can be performed by a variety of equipment such as front-end loaders, backhoes, clamshells, and draglines. The selection of equipment must consider several factors such as type of material, load-supporting ability of the soil, rate of excavation required, depth of excavation, and site access. The excavation can be backfilled to pre-excavation grades or can be partially backfilled as needed to establish more suitable ecological habitats or building sites. Backfilling is performed using clean fill and includes grading and revegetation.

Effectiveness

Excavation can be effective in the complete removal of contaminated material from a site. Confirmatory sampling is usually required to verify that all contaminated material has been removed. Soil samples can be collected from the sides and bottom of the excavation and analyzed for COCs to ensure that clean-up goals have been attained. It may also be possible to remove landfill waste from uncontaminated soil so that the soil can be returned to the site.

Implementability

Excavation equipment is readily available, and the technology is well proven and established in the construction and remediation industries. Excavation below the water table is not expected to be required, although it would be possible to lower the water table to below the bottom of the depth of excavation if needed. The removed water may need to be treated and disposed appropriately. As an alternative, “wet” excavation could be performed during which material from below the water is to be dredged and placed on a dewatering pad. The dried material would then be transported off site for disposal (waste and contaminated soil) or used as backfill (uncontaminated soil).

Cost

Excavation costs are typically low unless unusual conditions (e.g., excavation below water) are encountered.

Conclusion

Excavation is retained for further consideration.

3.4.2.5 Disposal

The technologies considered under disposal were on-site consolidation and off-site disposal in a hazardous or non-hazardous waste landfill.

On-site consolidation of waste would involve excavation of various areas (e.g., near the intermittent stream) followed by consolidation at one location where waste is already present. Consolidation would be performed to enhance the implementability of a multimedia cap, which would be placed over the consolidated waste.

Off-site disposal is applicable to excavated materials. Landfills differ in the types of waste they are permitted to accept. Non-hazardous waste landfills are permitted to accept municipal solid wastes, construction and demolition debris, contaminated soil, and other waste that must be proven to have non-hazardous characteristics. Hazardous waste landfills can accept listed and characteristic hazardous wastes as defined by RCRA.

Effectiveness

On-site consolidation can be effective for the types of materials present at Site 38. Removal of material along the intermittent stream with consolidation away from the intermittent stream would make it easier to install a multimedia cap.

Landfilling can be an effective method for waste disposal if the receiving facility is properly designed and operated.

Implementability

Excavation equipment used for consolidation is readily available. The technology is well proven and established in the construction and remediation industries.

There are no implementability concerns associated with off-site disposal. Based on available information, the waste at Site 38 is assumed to be non-hazardous.

Cost

Costs associated with on-site consolidation and disposal in a non-hazardous waste landfill would be low to moderate.

Conclusion

On-site consolidation is retained if needed to enhance the constructability of a multimedia cap. Off-site disposal is also retained for further consideration.

3.4.3 Selection of Representative Process Options

Table 3-2 summarizes the retained technologies and process options for soil and waste. Representative process options were chosen from each technology to assemble an adequate variety of effective and implementable alternatives and to evaluate the alternatives in sufficient detail to aid in the final selection process. The specific process options selected for the remedial action will be determined during the remedial design or during bid evaluation and selection of the remedial action contractor.

3.5 PRELIMINARY SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This Section identifies and screens remediation technologies and process options for groundwater at a preliminary stage based on implementation with respect to site conditions and contaminants of concern. Table 3-3 summarizes the preliminary screening of remediation technologies and process options applicable to groundwater. This table presents the GRAs, identifies the remediation technologies and process options, and provides a brief description of each process option followed by a screening comment.

The following are the groundwater remediation technologies and process options remaining for detailed screening:

General Response Action	Remediation Technology	Process Options
No Action	None	Not Applicable
Limited Action	Land Use Controls	Land Use Controls and Groundwater Use Restrictions
	Monitoring	Sampling and Analysis
	Natural Attenuation	Application of Natural Processes for the degradation of contaminants

More active technologies including extraction and in-situ treatment have not been evaluated due to the lack of significant groundwater contamination at the site.

3.6 DETAILED SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER

3.6.1 No Action

No Action consists of maintaining the current status of the site, i.e., no remedial action is taken under this response. As required under Comprehensive Environmental Response Compensation and Liability Act (CERCLA) regulations, the No Action alternative is carried through the FS to provide a baseline for comparison of alternatives and their effectiveness in mitigating risks posed by site contaminants.

3.6.2 Limited Action

3.6.2.1 Land Use Controls

LUCs would be developed to prevent unacceptable risks from exposure to contaminated groundwater. These LUCs would be formulated and implemented to prevent the use of the surficial aquifer groundwater at Site 38 as a source of drinking water.

Performance objectives and restrictions would be incorporated to:

- Prohibit all uses of groundwater from the surficial aquifer underlying the site (including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and industrial processes) unless prior written approval is obtained from the Navy, USEPA, and Maryland Department of the Environment (MDE).

- Maintain the integrity of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from the Navy, USEPA, and MDE.

Annual inspections of the site would be conducted to confirm compliance with LUC objectives, and an annual compliance certificate would be prepared and provided to USEPA and MDE. Prior to any property conveyance, USEPA and MDE would be notified.

The LUCs would be maintained for as long as they are required to prevent unacceptable exposure to contaminated groundwater and/or to preserve the integrity of the selected remedy.

<u>Effectiveness</u>

Groundwater use restrictions would be effective in combination with plume remediation activities. These controls would minimize potential human health risks associated with exposure to contaminated groundwater.

<u>Implementability</u>

LUCs would be readily implementable. NSF-IH will remain active in the future. Groundwater is currently not used as a drinking water source at NSF-IH. This technology will assure the limitation on the future use of groundwater and thus limit human exposure to groundwater.

<u>Cost</u>

Costs of LUCs would be low.

<u>Conclusion</u>

LUCs are retained in combination with other process options for the development of groundwater remedial alternatives.

3.6.2.2 Monitoring

Sampling and analysis of groundwater throughout the area of groundwater contamination could be used to evaluate migration of COCs and the potential for contamination of possible future on-site drinking water supply. Monitoring can also be used to monitor potential natural attenuation or the progress of active groundwater remediation.

Effectiveness

Monitoring would not of itself reduce the toxicity, mobility, or volume of COCs in the groundwater, but reduction in contaminant concentrations through natural attenuation is expected. Periodic groundwater monitoring would serve as a warning mechanism if a threat of contamination arose in the area. Monitoring would also be helpful in measuring and evaluating the effectiveness of natural attenuation and/or active remediation technologies.

Implementability

A groundwater monitoring program could be readily implemented at Site 38. Local and State permits would be required for monitoring well installation.

Cost

Capital and O&M costs of monitoring would be low.

Conclusion

Monitoring is retained in combination with other process options for the development of groundwater remedial alternatives.

3.6.2.3 Natural Attenuation

Natural attenuation would consist of monitoring groundwater quality to determine the extent to which natural processes would decrease contaminant concentrations over time. For this purpose, new monitoring wells would be installed as required and samples from these new wells and existing wells would be regularly collected and analyzed for Natural Attenuation parameters such as oxidation reduction potential (ORP), dissolved oxygen, pH, alkalinity, temperature, conductivity, biochemical and chemical oxygen demand, total organic carbon, ferrous and total iron, sulfur compounds (sulfides, sulfates), nitrogen compounds (nitrites, nitrates), orthophosphates, chloride, and metabolic gases (methane, ethane, ethane, carbon dioxide).

Effectiveness

Naturally occurring processes are expected to reduce manganese concentrations in the aquifer over the long term. Monitoring of indicator parameters within the aquifer would help to evaluate the effectiveness of Natural Attenuation in reducing contaminant concentrations.

Implementability

Natural attenuation would be easy to implement. Monitoring groundwater quality and periodically reviewing site conditions could readily be performed, and the necessary resources are available to provide these services.

Cost

Capital and O&M costs for natural attenuation would be low.

Conclusion

Natural Attenuation is retained in combination with other process options for the development of remedial alternatives.

3.6.3 Selection of Representative Process Options

Table 3-4 summarizes the retained technologies and process options for groundwater. Representative process options were chosen from each technology to assemble an adequate variety of effective and implementable alternatives and to evaluate the alternatives in sufficient detail to aid in the final selection process. The specific process options selected for the remedial action will be determined during the remedial design or during bid evaluation and selection of the remedial action contractor.

TABLE 3-1

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

General Response Action	Technology	Process Option	Description	Screening Comments
No Action	None	Not Applicable	No activities conducted to address contamination.	Required by NCP. Retain for baseline comparison.
Institutional Actions	Monitoring	Groundwater and Surface Water Monitoring	Periodic sampling and analysis to determine whether contamination is migrating and to determine effectiveness of remedial actions.	Retain to assess migration of contaminants and evaluation of remedial actions.
	Access/Use Restrictions	Physical Barriers	Fencing, markers, and warning signs to restrict site access.	Retain to limit exposure to contaminated media.
	Land Use Controls	Groundwater and Land Use Restrictions	Administrative actions using site use prohibitions to restrict future activities.	Retain to limit exposure to contaminated media.
Containment	Capping	Multimedia Cap	Use of low-permeability barriers to minimize exposure to and migration of contaminants. A RCRA Subtitle D capping system would be required.	Retain to minimize exposure to contaminated material and to minimize contaminant migration.
	Erosion Control	Vegetation	Use dense plant growth to minimize migration of waste.	Retain to minimize disruptive effects of remediation.
	Vertical Barriers	Slurry Wall, Grout Curtain, and Sheet Piling	Low-permeability wall formed in a perimeter trench to restrict horizontal movement of groundwater.	Eliminate. Off-site migration of contaminants from groundwater to surface water is not a concern.
Removal	Excavation	Excavation	Means for removal of waste.	Retain to remove contaminated media.
In-Situ Treatment	Thermal	Vitrification/Radio Frequency Heating	Use of high temperature to fuse inorganic contaminants into a glass matrix or use of moderate temperature to volatilize contaminants and remove them from vadose zone.	Eliminate because of ineffectiveness and implementability concerns under shallow groundwater conditions. Not proven effective with heterogeneous material (e.g., landfill waste).

TABLE 3-1

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

General Response Action	Technology	Process Option	Description	Screening Comments
In-Situ Treatment (Cont.)	Physical/Chemical	Soil Flushing	Use of water or solvents to remove contaminants from vadose zone by leaching and collecting contaminated wastewater in saturated zone followed by aboveground treatment.	Eliminate because of questionable effectiveness with heterogeneous material.
		Soil Vapor Extraction	Use of vacuum and possibly air sparging to remove contaminants from vadose zone.	Eliminate because volatile organic contaminants in soil are not a risk driver.
		Solidification	Use of pozzolanic materials in vadose zone to chemically fix inorganics and solidify matrix to reduce leachability.	Eliminate because of questionable effectiveness and implementability with heterogeneous material.
Ex-Situ Treatment	Physical/Chemical	Soil Washing/ Solvent Extraction	Use of water and solvents to remove contaminants from solid materials.	Eliminate because of questionable effectiveness with heterogeneous material.
		Solidification	Use of pozzolanic materials to chemically fix inorganics and solidify matrix to reduce leachability.	Eliminate because of questionable effectiveness and implementability with heterogeneous material.
	Biological	Landfarming	Tilling of contaminated soil in layers to remove volatile organic compounds and biodegrade organics.	Eliminate because it is not applicable to landfill material.
		Bioslurry Treatment	Treatment of soil in a slurry reactor under controlled conditions using natural or cultured microorganisms to biodegrade organics.	Eliminate because it is not applicable to landfill material.

TABLE 3-1

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

General Response Action	Technology	Process Option	Description	Screening Comments
Ex-Situ Treatment (Cont.)	Thermal	Incineration	Use of high temperature to destroy organic contaminants.	Eliminate because organics are not chemicals of concern.
		Low-Temperature Thermal Desorption	Use of low to moderate temperature to volatilize contaminants.	Eliminate because organics are not chemicals of concern.
Disposal	Landfilling	Hazardous or Non-Hazardous Waste Landfill	Disposal of excavated material at a permitted on-site or off-site landfill.	Retain off-site landfilling to permanently remove contaminated materials. Eliminate on-site landfilling because suitable area is not available.
		Consolidation	Excavation and placement in one location on site to minimize space and closure requirements.	Retain for possible combination and use with containment technology.

NCP National Oil and Hazardous Substances Pollution Contingency Plan.

TABLE 3-2

SUMMARY OF RETAINED TECHNOLOGIES AND PROCESS OPTIONS
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

General Response Action	Technology	Representative Process Option
No Action	None	Not Applicable
Institutional Actions	Monitoring	Groundwater and Surface Water Monitoring
	Land Use Controls	Shallow Groundwater and Land Use Restrictions
Containment	Capping	Multimedia Cap
	Erosion Control	Vegetation
Removal	Excavation	Excavation
Disposal	Landfilling	On-Site Consolidation
		Off-Site Landfilling

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 INTRODUCTION

This section presents the rationale for and the development of remedial alternatives evaluated in the FS. These alternatives were developed from the combinations of technologies and process options evaluated in Section 3.0.

4.2 RATIONALE FOR ALTERNATIVE DEVELOPMENT

The purpose of the FS was to evaluate the information developed during the SSP investigations that assessed site conditions and to develop an appropriate range of alternatives to allow remedy selection. According to CERCLA, the development of alternatives should reflect the scope and complexity of the site problems being addressed, and the number and types of alternatives should also be based on the site characteristics and complexity of site concerns. Development of alternatives for Site 38 was based on the following:

- Technologies and process options remaining after screening in Section 3.0
- Reasonably anticipated land use scenarios
- Exposure scenarios
- The RAO
- ARARs
- Sustainability evaluation

4.2.1 Technologies and Process Options

GRAs and representative process options were developed for the landfill at Site 38. The GRAs and process options retained for assembly into alternatives are:

General Response Action - Soil	Process Options
No Action	None
Institutional Action	Groundwater and Surface Water Monitoring
	Shallow Groundwater and Land Use Restrictions
Containment	Multimedia Cap
	Riprap Erosion Control
	Vegetative Erosion Control
Removal	Excavation
Disposal	On-Site Consolidation
	Off-Site Landfilling

General Response Action - Groundwater	Process Options
No Action	None
Institutional Actions	Monitoring
	Land Use Controls
	Natural Attenuation

These process options were used individually or in combination, as appropriate, to form remedial alternatives in Section 4.3.

4.2.2 Land Use Scenarios

Potential exposure to environmental media is evaluated in the context of current land use and future land use. Under current and future land use, Site 38 is not used and would remain as a former waste disposal area. Under future land use, Site 38 could be released to the public or remain under the control of the Navy. While under the control of the Navy, the site is expected to be inactive.

4.2.3 Exposure Scenarios

Assumptions for the land use scenarios and receptors used for alternative development are consistent with the human health and ecological risk screening evaluations contained in the SSP Report (Tetra Tech, 2008).

Under the current land use scenario, Site 38 is assumed to remain as it currently exists. No adverse health effects are expected for current human receptors. There are no unacceptable risks to ecological receptors.

Potential receptors under potential future land use scenarios include on-site residents. Possible adverse health effects would be expected for hypothetical future residents exposed to soil, waste, and groundwater. No adverse health effects would be expected for exposure to other environmental media. Potential risks to ecological receptors would not be expected.

4.2.4 Accommodation of RAOs and ARARs

In general, it is desirable to develop remedial alternatives that achieve compliance with all RAOs and ARARs. However, in certain cases, technical limitations and costs prevent the development of alternatives that attain all clean-up goals for all media.

Typically, alternatives are not assembled for the remediation of shallow groundwater at a landfill site as the groundwater would not be expected to be used as a drinking water source in the future. However for the purpose of this FS, alternatives for the remediation of groundwater at the site are being developed to fully evaluate landfill removal as a remedial alternative.

4.2.5 Sustainability Evaluation

Department of Defense (DoD) and Navy policies require continual optimization of remedies in every phase of remedy selection through site closeout. In August 2009 DOD issued policy for “Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program.” In response to this policy, the Navy issued an updated Navy Guidance for “Optimizing Remedy Evaluation, Selection, and Design” (Battelle, 2010), which includes sustainability evaluations as part of the traditional Navy optimization review process for remedy selection, design, and remedial action operation. In August 2010 NAVFAC issued policy requiring use of the SiteWise tool to perform sustainability reviews as part of all Feasibility Studies. As such, a sustainability evaluation of remedial alternatives was performed to estimate the environmental footprint associated with each alternative in the interest of increasing the sustainability of remedial action at Site 38. This evaluation can be found in Appendix C.

4.3 REMEDIAL ALTERNATIVE DEVELOPMENT

This section develops the remedial alternatives for Site 38 considering the information provided in Section 4.2. The following alternatives have been developed for the landfill:

- Alternative 1 – No Action
- Alternative 2 – Engineered Cap with Land Use Controls
- Alternative 3 – Landfill Removal, Monitoring and Land Use Controls

4.3.1 Alternative 1 – No Action

Under Alternative 1, no controls or remedial technologies would be implemented. The no action alternative is required by the NCP and is used as a baseline for comparison with other alternatives.

At least every 5 years, a site review would be conducted to evaluate the site status (i.e., the site’s then-current use and plans for future use), to review environmental laws and regulations in effect at the time of the review, and to provide direction for action, if deemed necessary. Site reviews are required because this alternative would allow the landfill to remain in place with soil and groundwater contaminants remaining at concentrations exceeding those suitable for unlimited use and unrestricted exposure.

4.3.2 Alternative 2 – Engineered Cap and Land Use Controls

Alternative 2 includes construction of an engineered cap, LUCs, monitoring, and five-year reviews.

The landfill would be cleared of all vegetation, filled, and graded to an acceptable slope, capped, and revegetated. The engineered cap would consist of several layers including (from the bottom to top) a gas management layer, low-permeability layer, drainage layer, final earthen cover, and vegetative stabilization.

LUCs would consist of maintaining records of the restrictions in the GIS maintained by NSF-IH. Unauthorized excavation, residential development, and shallow groundwater use would not be permitted. Maintaining information in the GIS would ensure that the Navy would be able to take adequate measures to minimize the potential for adverse human and environmental effects at the time of any future land development.

Monitoring would include sampling of shallow groundwater beneath Site 38 and analysis for MDE required groundwater analytes. The objective of monitoring would be to confirm that no contaminants are migrating from the site at unacceptable levels and to confirm the effectiveness of the remedy.

At least every 5 years, a site review would be conducted to evaluate the monitoring results, to evaluate the site status (i.e., the sites then-current use and plans for future use), to review environmental laws and regulations in effect at the time of the review, and to provide direction for further action, if deemed necessary. Site reviews are required because this alternative would allow the landfill to remain in place with groundwater contaminants remaining at concentrations exceeding those suitable for unlimited use and unrestricted exposure.

4.3.3 Alternative 3 – Landfill Removal, Monitoring and Land Use Controls

Alternative 3 includes debris and landfill removal. Landfill materials would be excavated and transported off site for disposal. All of the waste observed in previous soil borings was above the water table (approximately 10 to 25 feet bgs). The site would not be backfilled, and the excavated area would be regraded and soil and seed be added for vegetated growth to match the surrounding area.

LUCs would consist of maintaining records of the restrictions in the GIS maintained by NSF-IH. Potable use of shallow groundwater would not be permitted. Maintaining information in the GIS would ensure that the Navy would be able to take adequate measures to minimize the potential for adverse human and environmental effects at the time of any future land development.

A groundwater investigation would be conducted to further characterize contaminant concentrations at the site following the removal of the landfill waste. The investigation would be conducted to determine if the existing groundwater contamination is attributable to the landfill or another upgradient source. A monitoring program for the shallow groundwater would be developed to confirm that contaminant concentrations identified previously at the site are attenuating and to confirm the effectiveness of the remedy.

At least every 5 years, a site review would be conducted to evaluate the monitoring results, to evaluate the site status (i.e., the sites then-current use and plans for future use), to review environmental laws and regulations in effect at the time of the review, and to provide direction for further action, if deemed necessary. Site reviews are required because this alternative would allow groundwater contaminants to remain at concentrations exceeding those suitable for unlimited use and unrestricted exposure.

4.4 SCREENING OF ALTERNATIVES

Alternatives can be screened to decrease the number of alternatives that are carried forward for detailed analysis. This step in the FS process is conducted, when appropriate, to eliminate alternatives that do not achieve protection of human health and the environment. Alternatives should be eliminated if they are significantly less effective than more promising alternatives, are not technically or administratively implementable, or have significantly greater costs.

The alternatives developed and described for Site 38 are considered to represent an appropriate range of alternatives. All alternatives are considered effective and implementable; therefore, all of the alternatives were carried forward for detailed analysis.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

In this section, each remedial alternative developed in Section 4.0 is described and analyzed in detail. The detailed analysis was conducted in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1998b) and the NCP. The detailed analysis of remedial alternatives provides information for the comparison of alternatives in Section 6.0 and the selection of a preferred alternative in the Proposed Plan. The following criteria were used for the detailed analysis of each alternative:

Threshold Criteria

- Overall protection of human health and the environment
- Compliance with ARARs

Primary Balancing Criteria

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria

- State acceptance
- Community acceptance
- Sustainability

The first two criteria are threshold criteria in that each alternative must meet them. The next five criteria are grouped together because they represent the primary criteria on which the analysis is based. The alternative that best matches the five balancing criteria is proposed to EPA, the state, and the community as the preferred remedy. State and community acceptance will be evaluated following comments on the FS and Proposed Plan and will be addressed after a final decision is made and the Record of Decision (ROD) is being prepared. Sustainability is also a modifying criteria, and the attached Environmental Footprint Evaluation in Appendix C is used as an additional tool in the decision making process. The following is a description of each of the 10 evaluation criteria.

Overall Protection of Human Health and the Environment - The primary requirement for CERCLA remedial actions is that they are protective of human health and the environment. A remedy is protective if it adequately eliminates, reduces, or controls all current and potential future risks. All pathways of exposure must be considered when evaluating the remedial alternative. If hazardous substances remain without engineering or land use controls after the remedy is implemented, the evaluation must consider unrestricted land use and unlimited exposure for human and environmental receptors. For those sites where hazardous substances remain and unrestricted use and unlimited access are not allowable, engineering controls, LUCs, or some combination of the two must be implemented to control exposure and ensure reliable protection over time. In addition, implementation of a remedy cannot result in unacceptable short-term risks to or cross-media impacts on human health and the environment.

Compliance with ARARs - Compliance with ARARs is one of the statutory requirements for remedy selection. Alternatives are developed and refined throughout the FS process to ensure that they will meet all their respective ARARs or that there is adequate rationale for waiving an ARAR. Alternatives may be refined to ensure compliance with these requirements.

Long-Term Effectiveness and Permanence - This criterion reflects the CERCLA emphasis on implementing remedies that will ensure protection of human health and environment in the future, as well as in the near term. In evaluating alternatives for long-term effectiveness and the degree of permanence they afford, the analysis focuses on the residual risks that will remain at the site after completion of the remedial action. This analysis also considers the following:

- Degree of threat posed by the hazardous substances remaining at the site
- Adequacy of any controls (e.g., engineering and land use controls) used to manage the hazardous substances remaining at the site
- Reliability of those controls
- Potential impacts on human health and the environment if the remedy should fail

Reduction of Toxicity, Mobility, or Volume Through Treatment - This criterion addresses the statutory preference for remedies that employ treatment as a principal element by ensuring that the relative performance of the various treatment alternatives in reducing toxicity, mobility, or volume will be assessed. The analysis also examines the magnitude, significance, and irreversibility of reductions.

Short-Term Effectiveness - This criterion examines the short-term impacts of the alternatives (i.e., impacts of the implementation) on the neighboring community, workers, and surrounding environment. This includes potential threats to human health and the environment associated with excavation, treatment, and transportation of hazardous substances. The potential cross-media impacts of the remedy and the time to achieve protection of human health and the environment are also analyzed during evaluation of this criterion.

Implementability - Implementability considerations include the technical and administrative feasibility of the alternative. Implementability also considers the availability of goods and services (e.g., treatment, storage, or disposal capacity) on which the viability of the alternative depends. Implementation considerations often affect the timing of the various alternatives (e.g., limitations on the season in which the remedy can be implemented, the number and complexity of material-handling steps that must be followed, the need to obtain permits for off-site activities, and the need to secure technical services).

Cost - Cost includes all capital and O&M costs incurred over the life of the project. The focus of the detailed analysis is on the net present values of these costs. Costs are used to select the least expensive or most cost-effective alternative that will achieve RAOs. A 30-year maintenance life and a 7-percent annual discount factor are used to calculate the present worth of the capital and O&M costs. Costs are derived from experience on similar projects, vendor quotes from companies specializing in the item of interest, and/or published cost estimating literature.

State Acceptance - This criterion, which is an ongoing consideration during the remediation process, reflects the statutory requirement to provide substantial and meaningful state involvement.

Community Acceptance - This criterion refers to community comments on the remedial alternatives under consideration. Community is broadly defined to include all interested parties. These comments are taken into account throughout the FS process; however, only preliminary assessment of community acceptance can be conducted during development of the FS. Formal public comments will not be received until after the public comment period for the preferred alternative is held.

Sustainability - This criterion refers to the greenhouse gas (GHG) emissions, energy use, water consumption, criteria pollutant emissions, and worker safety for each alternative. As required by Navy policy, sustainability should be taken into consideration throughout all phases of remediation.

5.2 DESCRIPTION AND ANALYSIS OF ALTERNATIVES

5.2.1 <u>Alternative 1 – No Action</u>

5.2.1.1 Detailed Description

Under Alternative 1, no controls or remedial technologies would be implemented to address landfill waste and surface soil or groundwater contamination. The no-action alternative is required by the NCP and is used as a baseline for comparison with other alternatives. For this alternative, the site would be available for unrestricted use because no LUCs would be implemented.

<u>Site Review</u>

At least every 5 years, a site review would be conducted to evaluate the site status and to determine whether action is necessary. These site reviews are required because this alternative would allow contaminants to remain at the site in excess of levels that allow for unlimited use and unrestricted exposure. The reviews will follow Federal and DoD policies that require evaluation of the effectiveness of LUCs in protecting human health and the environment and/or the condition of the protective engineered remedy. When the Five-Year Review indicates that the remedy is not performing as designed, the report would recommend actions to improve performance.

5.2.1.2 Overall Protection of Human Health and the Environment

Alternative 1 would not be protective of human health and the environment. Landfill waste and surface soil contamination could pose a potential future threat under the residential exposure scenario.

5.2.1.3 Compliance with ARARs

Alternative 1 would not comply with ARARs, including state landfill closure requirements.

5.2.1.4 Long-Term Effectiveness and Permanence

The future threats to human health and the environment would remain. There would be no long-term management controls; therefore, the adequacy and reliability of controls would not be applicable. There would be no long-term monitoring program to confirm that contaminant migration from the site is not occurring.

5.2.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not include treatment to reduce the toxicity, mobility, or volume of the hazardous substances on site.

5.2.1.6 Short-Term Effectiveness

Alternative 1 would not pose any short-term risks to the local community or on-site workers during implementation because no actions would occur. There would be no environmental risks from implementation.

5.2.1.7 Costs

There is no cost associated with Alternative 1.

5.2.1.8 State Acceptance

The no-action alternative would not be recommended because it does not meet the threshold criteria; therefore, there would be no opportunity for state review, comments, or acceptance.

5.2.1.9 Community Acceptance

The no-action alternative would not be recommended because it does not meet the threshold criteria; therefore, there would be no opportunity for community review, comments, or acceptance.

5.2.1.10 Sustainability

This alternative was not evaluated as there are no sustainability impacts aside from the Five-Year Reviews.

5.2.2 Alternative 2 – Engineered Cap and Land Use Controls

5.2.2.1 Detailed Description

Under Alternative 2, an engineered cap would be installed, and LUCs would be implemented to protect human health by ensuring that there is no unauthorized excavation, residential use, or shallow groundwater use. Monitoring would be performed to confirm that contaminants are not migrating off site at unacceptable levels.

Engineered Cap

Capping the landfill would be a containment action. The purpose of capping would be to eliminate or reduce the possibility of human exposure to potential physical hazards, reduce the rate of surface water infiltration, and reduce erosion. An area of approximately 0.85 acres would be capped (see Figure 5-1). The existing landfill material would be regraded to provide sufficient slope to promote drainage from the completed cap and to provide a bedding layer for the cap. Following regrading, a cap system with the following layers (from bottom to top) would be installed (see Figure 5-2):

- Geotextile
- 6-inch gas management layer
- Geotextile
- Low-permeability synthetic geomembrane with a minimum thickness of 40 mils
- Geotextile
- 12-inch drainage layer
- Geotextile
- 18-inch layer of clean common soil fill
- 6-inch layer of clean topsoil
- Vegetative stabilization layer

Land Use Controls

Land and groundwater use restrictions would be implemented to eliminate or reduce exposure pathways. LUCs would consist of maintaining records of the restrictions in the NSF-IH GIS. The information in the GIS would ensure that the Navy would be able to take adequate measures to minimize adverse human health effects at the time of any future land development. Unauthorized excavation, residential use, and shallow groundwater use would not be permitted. A LUC Remedial Design would need to be prepared to document these restrictions.

Monitoring

To accommodate placement of the engineered cap, existing monitoring wells would be modified when required in accordance with state regulations. Monitoring of shallow groundwater would be conducted to confirm that groundwater contaminant migration is not occurring. It is assumed that samples would be collected quarterly from four site monitoring wells. All samples would be analyzed for parameters required by MDE. A long-term monitoring plan would need to be developed with EPA and MDE concurrence.

Site Reviews

At least every 5 years, a site review would be conducted to evaluate the monitoring results, to evaluate the site status, and to determine whether further action is necessary. The site reviews are required because this alternative would allow contaminants to remain at the site in excess of levels that allow for unlimited use and unrestricted exposure.

5.2.2.2 Overall Protection of Human Health and the Environment

Alternative 2 would protect human health by installing an engineered cap, and implementing land and groundwater use restrictions. This would reduce the potential for human exposure to landfill waste through dermal contact and exposure to potential groundwater contaminants through ingestion and dermal contact. Groundwater monitoring would help in confirming the effectiveness of this alternative, determining whether contaminants are migrating at unacceptable levels, and evaluating whether further action is required.

5.2.2.3 Compliance with ARARs

There are no chemical-specific ARARs associated with this alternative. Although manganese was detected in groundwater within monitoring wells at the site, groundwater beneath the landfill is not within the area of attainment as defined by EPA.

This alternative would comply with state closure (i.e., capping) standards and post-closure maintenance and monitoring requirements for sanitary landfills.

5.2.2.4 Long-Term Effectiveness and Permanence

The landfill waste and surface soil contaminants would remain at the site and the entire landfill would be permanently capped. Land and groundwater use restrictions would reduce the potential human health hazards associated with exposure to landfill waste and shallow groundwater under a residential use exposure scenario. Monitoring would be used to confirm the effectiveness of this alternative, determine whether contaminants are migrating at unacceptable levels, and evaluate whether future action is required.

Land and groundwater use restrictions would be protective over the long term. A five-year periodic review of the site would be conducted as long as landfill waste and groundwater contaminants remain at concentrations that exceed those suitable for unlimited use and unrestricted exposure. Any private ownership of the land in the future would need to be controlled under a deed restriction to control land and groundwater use.

5.2.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would not include treatment to reduce the toxicity, mobility, or volume of contaminants at the site.

5.2.2.6 Short-Term Effectiveness

The remedial activities associated with construction of an engineered cap would not be expected to have an adverse impact on the community.

Exposure of workers to contaminated media during capping and monitoring activities would be minimized by the use of personal protective equipment (PPE), engineering controls, and compliance with a site-specific health and safety plan (HASP) and Occupation Safety and Health Administration (OSHA) regulations.

Installation of the engineered cap would require that all existing vegetation be removed from the site. This would destroy the existing ecological habitat until the vegetation to be planted on the cap had become established. The cap could not be vegetated with brush and trees, which comprise much of the existing vegetation. The cap would need to be vegetated with plants such as grasses that would not penetrate the impermeable synthetic geomembrane. This could permanently alter the existing ecological habitat.

Installation of the engineered cap could have a short-term impact on area waterways. Erosion controls would be used during earth-moving activities to prevent migration of soil to any waterway. Any dust that is generated could be adequately controlled.

It is expected that the RAO could be achieved within a two-month construction duration.

5.2.2.7 Implementability

Alternative 2 would be implementable. Equipment and services needed to remove debris in the landfill area and construct the engineered cap are readily available. Land and groundwater use restrictions could be strictly enforced because the site is located within a military facility.

5.2.2.8 Cost

The estimated costs for Alternative 2 would be:

- Capital: $ 1,129,000
- O&M: $ 18,000 per year plus $ 25,300 every 5 years
- Present worth: $ 1,641,000

The present worth is based on a 30-year monitoring period. Conceptual design calculations and details of the cost estimates are provided in Appendix D.

5.2.2.9 State Acceptance

State acceptance would be addressed following receipt of comments on the FS and Proposed Plan.

5.2.2.10 Community Acceptance

Community acceptance would be addressed in the ROD following the public comment period on the FS and Proposed Plan.

5.2.2.11 Sustainability

Within the limits of the sustainability evaluation, Alternative 2 has the greatest environmental impact due to the large amount of materials needed to construct the cap. This is explained in further detail in the Environmental Footprint Evaluation in Appendix C.

5.2.3 <u>Alternative 3 – Landfill Removal, Monitoring and Land Use Controls</u>

5.2.3.1 Detailed Description

Under Alternative 3, the entire landfill and debris present in the landfill area would be removed. LUCs would be implemented to protect human health by ensuring that there is no potable use of shallow groundwater use. Monitoring would be performed to confirm that contaminants are attenuating and not migrating off site at unacceptable levels.

<u>Debris and Landfill Removal</u>

The debris and landfill contents would be excavated and transported off site for disposal at a permitted non-hazardous waste landfill. All of the waste encountered at the site is believed to be present above the water table, and it would not be difficult to excavate. After excavation, any wet excavated material (due to precipitation) would need to be dewatered before it could be transported off site. The water would be allowed to drain back into the excavation, and the waste would be allowed to dry naturally until landfill waste acceptance criteria are met. Also, all excavated material would be screened and inspected for MEC before it is transported off site. It is estimated that 4,080 cubic yards of materials would require excavation. The excavation would proceed vertically until waste is no longer encountered based on visual inspection of the material being excavated. Soil samples would then be collected from the excavated area to verify the adequacy of the removal and confirm that contaminants are not present in the subsurface soil.

The site would not be backfilled following excavation to return the area to the approximate elevation prior to use as a landfill. The site would be regraded to match the surrounding area. For cost estimation purposes, it was assumed that only top soil and seeding would be placed following excavation and regrading.

Land Use Controls

Groundwater use restrictions would be implemented to eliminate or reduce exposure pathways. LUCs would consist of maintaining records of the restrictions in the NSF-IH GIS. The information in the GIS would ensure that the Navy would be able to take adequate measures to minimize adverse human health effects at the time of any future land development. Shallow groundwater use would not be permitted. A LUC Remedial Design would need to be prepared to document these restrictions.

Monitoring

A groundwater investigation would be conducted to determine if the existing groundwater contamination is attributable to the landfill or another upgradient source. Monitoring of shallow groundwater would be conducted to confirm that groundwater contaminants are attenuating and migration is not occurring. It is assumed that samples would be collected annually from four site monitoring wells. All samples would be analyzed for parameters required by MDE. A long-term monitoring plan would need to be developed with EPA and MDE concurrence. It is assumed that 15 years of groundwater monitoring would be necessary to confirm that groundwater contaminants have attenuated to levels acceptable to the MDE and migration has not occurred.

Site Reviews

At least every 5 years, a site review would be conducted to evaluate the monitoring results, to evaluate the site status, and to determine whether further action is necessary. The site reviews are required because this alternative would allow groundwater contaminants to remain at the site in excess of levels that allow for unlimited use and unrestricted exposure.

5.2.3.2 Overall Protection of Human Health and the Environment

Alternative 3 would protect human health by removing all landfill waste from the site. Alternative 3 would also protect human health by implementing land and groundwater use restrictions. This would reduce the potential for human exposure to groundwater contaminants through ingestion and dermal contact. Groundwater monitoring would help in confirming the effectiveness of this alternative, determining whether contaminants are attenuating or migrating at unacceptable levels, and evaluating whether further action is required.

5.2.3.3 Compliance with ARARs

There are no chemical-specific ARARs associated with this alternative.

This alternative could be designed to meet action-specific ARARs associated with waste generation and storm water management during construction.

5.2.3.4 Long-Term Effectiveness and Permanence

Landfill waste would be permanently removed from the site. Groundwater use restrictions would reduce the potential human health hazards associated with exposure to shallow groundwater under a residential use exposure scenario. Monitoring would be used to confirm the effectiveness of this alternative, determine whether contaminants are attenuating or migrating at unacceptable levels, and evaluate whether future action is required.

Groundwater use restrictions would be protective over the long term. A five-year periodic review of the site would be conducted as long as groundwater contaminants remain at concentrations that exceed those suitable for unlimited use and unrestricted exposure. Any private ownership of the land in the future would need to be controlled under a deed restriction to control groundwater use.

5.2.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 would not include treatment to reduce the toxicity, mobility, or volume of contaminants at the site.

5.2.3.6 Short-Term Effectiveness

Excavation and off-site transport of wastes would have short-term impacts on the community, on-site workers, and the environment. Hauling wastes off site would generate additional traffic. Although there would be a potential for spills during transport, all materials would be solids that could easily be placed into the transport container. Any dust that would be generated during construction activities could be adequately controlled.

Exposure of workers to contaminated media during excavation activities would be minimized by the use of PPE, engineering controls, and compliance with a site-specific HASP and OSHA regulations. Because of the past and ongoing mission of NSF-IH, MEC could be encountered during excavation activities. Unexploded ordnance (UXO) technicians would need to inspect areas to be excavated to address potential munitions safety issues.

Removing the landfill would destroy the existing ecological habitat. The landfill area would be revegetated with grasses upon complete landfill removal. In the following years, shrubs and trees from the surrounding area would repopulate the area. Erosion controls would be used during earth-moving activities to prevent migration of soil and waste to area waterways. There could be localized short-term impacts in the area until concentrations of the groundwater contaminants are diluted.

It is expected that the RAO could be achieved within the construction duration of two months.

5.2.3.7 Implementability

Alternative 3 would not be difficult to implement. There are implementability concerns associated with screening excavated materials for MEC. Groundwater use restrictions could be strictly enforced because the site is located within a military facility.

Alternative 3 would involve procedures for MEC avoidance, removal, treatment/demilitarization, and disposal.

5.2.3.8 Cost

The estimated costs for Alternative 3 would be:

- Capital: $ 1,672,000
- O&M: $ 19,600 per year plus $ 25,300 every 5 years
- Present worth: $ 1,987,000

The present worth is based on a 15-year monitoring period. Conceptual design calculations and details of the cost estimates are provided in Appendix D.

5.2.3.9 State Acceptance

State acceptance would be addressed following receipt of comments on the FS and Proposed Plan.

5.2.3.10 Community Acceptance

Community acceptance would be addressed in the ROD following the public comments period on the FS and Proposed Plan.

5.2.3.11 Sustainabilty

Alternative 3 has a smaller but similar environmental impact when compared to Alternative 2. The equipment required to remove the landfill is the main contributor to emissions. This is explained in further detail in the evaluation in Appendix C.

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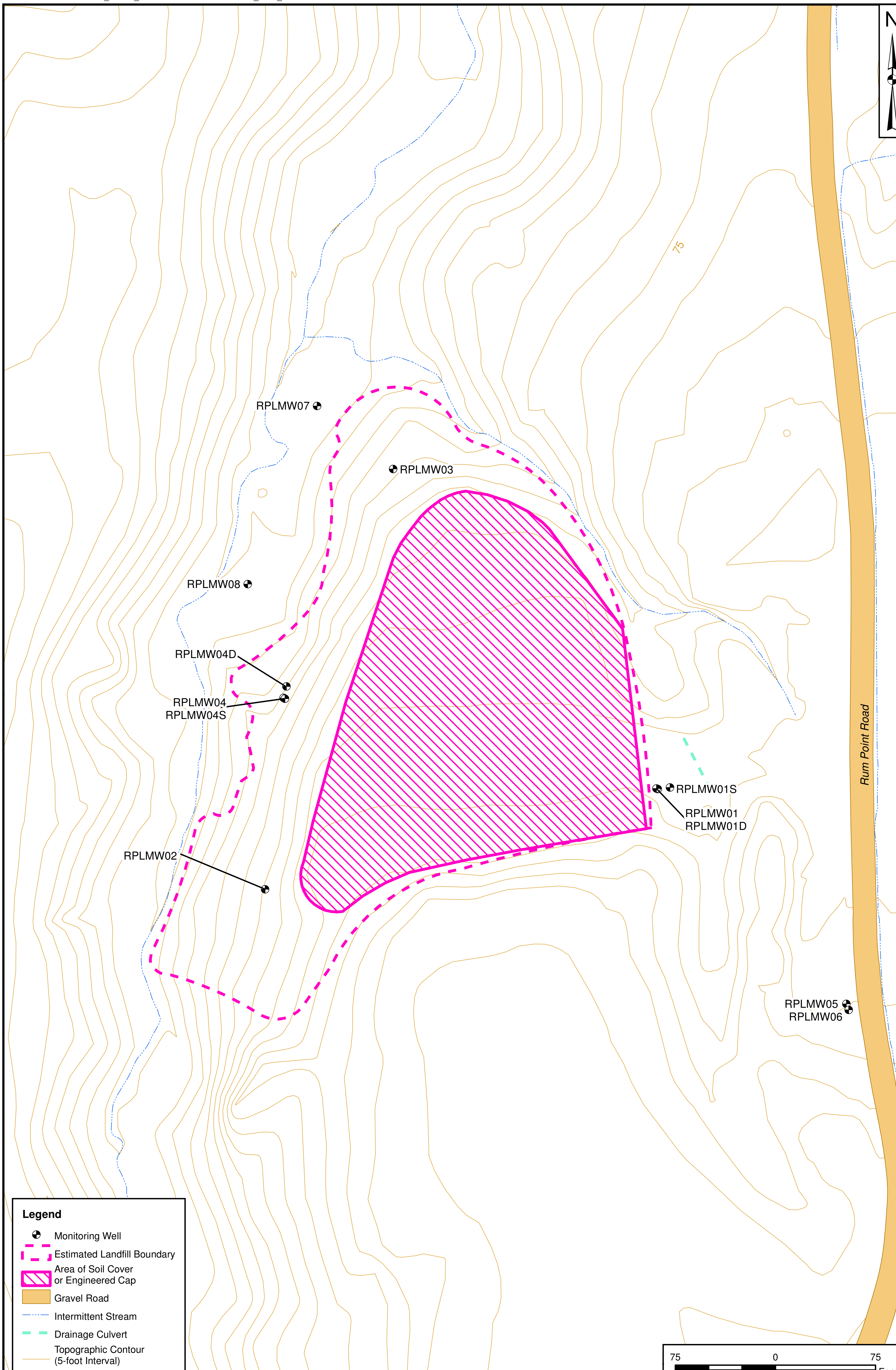
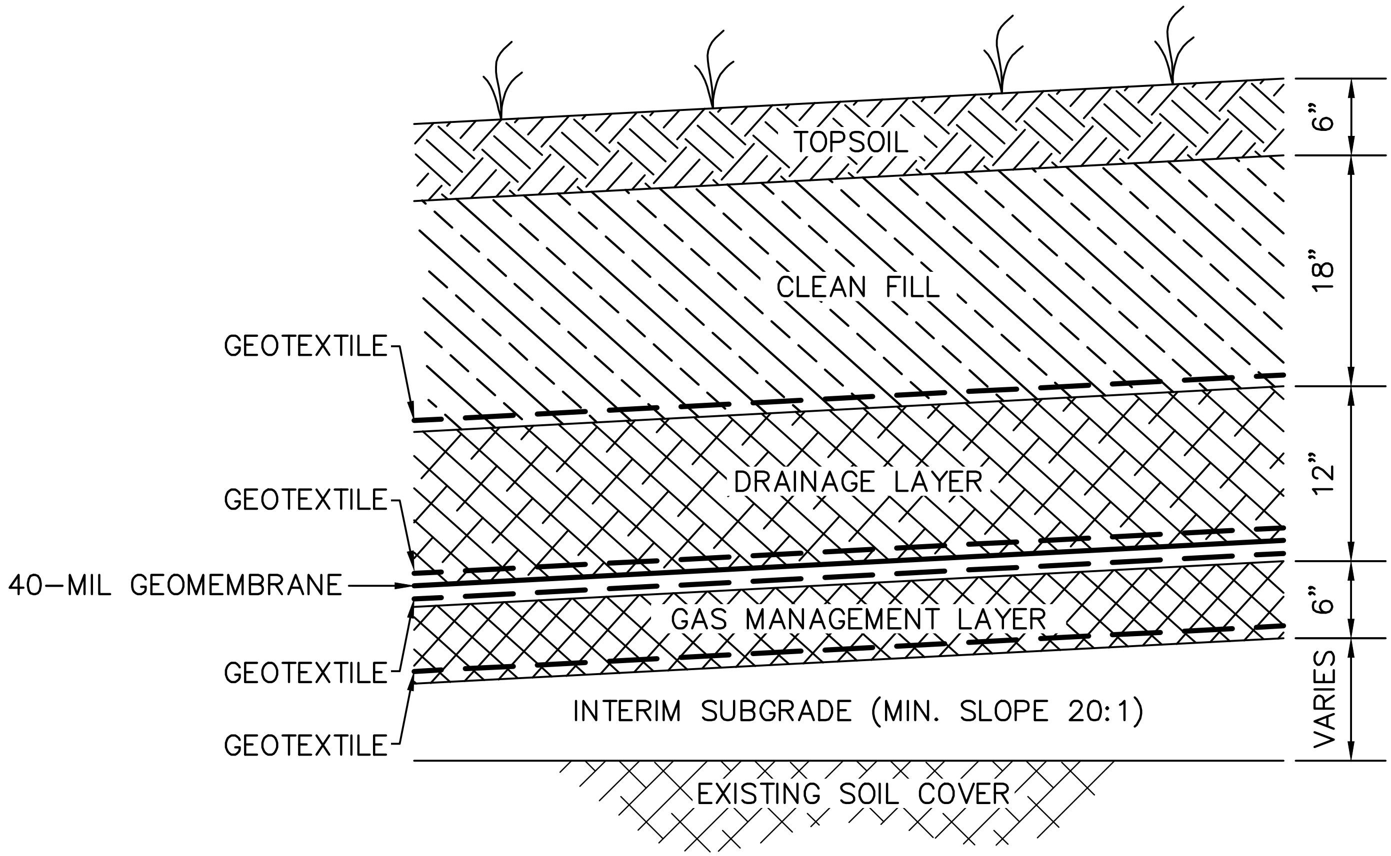


DRAWN BY J. ENGLISH	DATE 11/30/10	TETRA TECH	CONTRACT NUMBER	OWNER NUMBER CTO JU03
CHECKED BY S. VASKO	DATE 07/03/12	ALTERNATIVE 2 ENGINEERED CAP SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY	DATE
REVISED BY S. PAXTON	DATE 07/03/12		APPROVED BY	DATE
SCALE AS NOTED			FIGURE NO. FIGURE 5-1	REV 0



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ALTERNATIVE 2 – ENGINEERED CAP CROSS-SECTION
SITE 38 – RUM POINT LANDFILL
NAVAL SUPPORT FACILITY
INDIAN HEAD, MARYLAND
SCALE: NOT TO SCALE

DATE:	11-30-10
PROJECT NO.:	112G00928
DESIGNED BY:	
DRAWN BY:	CK
CHECKED BY:	
SHEET: 2 OF 2	

FIGURE 5-2

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6.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, the alternatives were evaluated in relation to one another with respect to each of the evaluation criteria. The purpose of this analysis was to identify the relative advantages and disadvantages of each alternative.

Table 6-1 summarizes the comparative analysis of alternatives for Site 38.

6.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

All the alternatives, except Alternative 1 (No Action), would provide adequate protection of human health.

Alternative 3 (Landfill Removal, Monitoring and LUCs) would protect human health and the environment to the greatest extent by removing all landfill waste and monitoring natural degradation processes for groundwater.

Alternative 2 (Engineered Cap) would protect human health to a lesser extent through implementation of LUCs to restrict land and groundwater use.

Alternatives 2 and 3 would include shallow groundwater monitoring to protect human health and the environment. Monitoring would provide evidence that contaminants are not migrating off site at unacceptable levels and provide information required to make a decision to cease monitoring. The engineered cap under Alternative 2 would reduce infiltration and the potential for migration of contaminants to shallow groundwater.

Shallow groundwater contaminants would be allowed to naturally attenuate under Alternatives 2 and 3. Under Alternative 2, shallow groundwater beneath the landfill is not within the area of attainment as defined by EPA; therefore, remediation of shallow groundwater would not be required as long as contaminants are not migrating off site.

6.2 COMPLIANCE WITH ARARs

Chemical-specific ARARs were identified for groundwater at the site. Although manganese concentrations in shallow groundwater are elevated within the landfill, under Alternative 2 groundwater beneath the landfill is not within the area of attainment as defined by EPA. Monitoring of natural attenuation of the manganese contamination would be conducted under Alternative 3.

Alternatives 2 and 3 would comply with action-specific ARARs, including state sanitary landfill closure requirements. Alternatives 2 and 3 would also comply with post-closure maintenance and monitoring requirements.

6.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 3 would be the most protective over the long term because all landfill waste would be removed from the site. However, LUCs and long-term monitoring would be required as groundwater contamination would remain. Monitoring included under Alternative 3 would be used to confirm the effectiveness of the alternative, determine whether contaminants were attenuating or migrating off site at unacceptable levels, and evaluate whether future action is required.

Alternative 2 would be less effective in the long term because the landfill waste and contaminated surface soil would remain on site, and LUCs would be needed to restrict land and groundwater use. However, the long-term effectiveness of the alternative would be monitored, and corrective measures could be taken if necessary. Although infiltration and off-site contaminant migration are not posing unacceptable risks to human health or the environment, the engineered cap included under Alternative 2 would reduce infiltration and contaminant migration.

Monitoring included under Alternative 2 would be used to confirm the effectiveness of these alternatives, determine whether contaminants are migrating off site at unacceptable levels, and evaluate whether future action is required.

Alternative 1 would not be effective in the long term. The future threats to human health and the environment would remain, and there would be no long-term management or monitoring of the site.

6.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

None of the alternatives include treatment to reduce the toxicity, mobility, or volume of contaminants at the site.

6.5 SHORT-TERM EFFECTIVENESS

There would be no short-term effectiveness concerns for Alternative 1 because no action would be implemented.

There would be no adverse impact on the community from implementation of Alternative 2. For Alternative 3, hauling wastes off site would generate additional traffic. Although there would be a potential for spills during transport, all materials would be solids that could easily be placed into the transport container.

There would be no adverse impacts to on-site workers from implementation of Alternative 2. Exposure of remediation workers to contaminated materials under Alternatives 2 and 3 would be controlled by the use of appropriate PPE, engineering controls, and compliance with a site-specific HASP and OSHA regulations.

Implementation of Alternatives 2 and 3 would require that all existing vegetation be removed from the site. For Alternative 2, this would destroy the existing ecological habitat until the vegetation planted on the soil engineering cap becomes established. For Alternative 2, the cap could not be planted with brush and trees, which comprise much of the existing vegetation. The cap would need to be vegetated with plants such as grasses that would not penetrate the impermeable layer. Following implementation of Alternative 3, the area would be seeded with grasses and, over time, would be naturally populated with shrubs and trees.

Implementation of Alternatives 2 and 3 could have short-term impacts on the intermittent stream adjacent to the site. Erosion controls would be used during earth-moving activities to prevent migration of soil to surface water. Any dust generated during excavation activities could be adequately controlled.

Alternative 1 would not attain the RAOs. The RAOs could be achieved within the following time frames for the other alternatives:

- Alternative 2: two months
- Alternative 3: two months

6.6 IMPLEMENTABILITY

No remedial actions would be implemented under Alternative 1.

Alternatives 2 and 3 are readily implementable. Equipment and services necessary to remove debris and construct an engineered cap are readily available. Land and groundwater use restrictions could be strictly enforced because the site is located within a military facility.

Implementability concerns associated with MEC materials could impact the construction activities of Alternative 3. This alternative would involve procedures for MEC avoidance, removal, treatment/demilitarization, and disposal.

6.7 COST

The 30-year present-worth costs of the alternatives would be:

- Alternative 1: $0
- Alternative 2: $ 1,641,000
- Alternative 3: $ 1,987,000

6.8 STATE ACCEPTANCE

State acceptance of Alternative 2, or 3 would be addressed following receipt of comments on the FS and Proposed Plan. Alternative 1 would not be recommended because it does not meet the threshold criteria.

6.9 COMMUNITY ACCEPTANCE

Community acceptance of Alternative 2 or 3 would be addressed in the ROD following the public comment period on the FS and Proposed Plan. Alternative 1 would not be recommended because it does not meet the threshold criteria.

6.10 SUSTAINABILITY

Alternative 2 has the greatest greenhouse gas emissions, energy use, and water consumption of all three alternatives evaluated, which is attributed to the materials needed to construct the cap. Alternative 3 has a similar impact to Alternative 2 for energy use and greenhouse gas emissions, but a higher cost. Details on this evaluation can be found in Appendix C.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES
SITE 38 – RUM POINT LANDFILL
NSF-IH, INDIAN HEAD, MARYLAND

Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Engineered Cap and Land Use Controls	Alternative 3 – Landfill Removal, Monitoring and Land Use Controls
Threshold Criteria			
Overall Protection of Human Health and the Environment	No reduction in potential risks.	Engineered cap and LUCs would reduce risks to human health and the environment.	Landfill removal and LUCs would reduce risks to human health and the environment. Natural attenuation at groundwater contaminants would reduce risks to hypothetical future site residents.
Compliance with ARARs			
Chemical-specific	Not applicable.	Could be designed to attain ARARs that apply.	Could be designed to attain ARARs that apply.
Location-specific	Not applicable.	Could be designed to attain ARARs that apply.	Could be designed to attain ARARs that apply.
Action-specific	Not applicable.	Could be designed to attain ARARs that apply.	Could be designed to attain ARARs that apply.
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	Would allow uncontrolled risks to remain.	Engineered cap and LUCs would reduce risks to human health. Monitoring and use restrictions would provide adequate and reliable controls.	Landfill removal and LUCs would eliminate risks to human health. Monitoring and use restrictions would provide adequate and reliable controls.
Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment.	No treatment.	No treatment.
Short-Term Effectiveness	Not applicable. No short-term impacts or concerns.	No impacts to community. Exposure of workers to contaminated media could be adequately controlled. Existing habitat would be destroyed until cap is revegetated; could not be planted with existing types of vegetation that could damage impermeable layer. It is expected that the RAO could be achieved within a two-month construction duration.	Hauling wastes off site would generate additional traffic. Exposure of workers to contaminated media could be adequately controlled. Existing terrestrial habitat would be destroyed and would revert to open water or converted to wetland. It is expected that the RAO could be achieved within the construction duration of two months.
Implementability	Nothing to implement.	Alternative consists of common remediation methods that are readily available and implementable. LUCs could be strictly enforced because site is located at military facility.	Alternative consists of common remediation methods that are readily available. There are implementability concerns associated with screening excavated materials for MEC. LUCs could be strictly enforced because site is located at military facility.
Cost			
Capital	$0	$ 1,129,000	$ 1,672,000
O&M		$ 18,000 per year plus $ 25,300 every 5 years	$ 19,600 per year plus $ 25,300 every 5 years
Present Worth		$ 1,641,000	$ 1,987,000
Modifying Criteria			
State Acceptance	Not applicable.	To be determined.	To be determined
Community Acceptance	Not applicable.	To be determined.	To be determined.
Sustainability	Not applicable.	Greatest environmental impact in terms of greenhouse gas emissions, energy use, water use, and some criteria pollutants. This impact is driven by the materials needed to construct the cap.	Equipment use for removing the landfill drives greenhouse gas emissions and energy use up. This alternative has a similar, but lesser, environmental impact when compared to Alternative 2.

ARARs Applicable or relevant and appropriate requirements.
MEC Munitions and explosives of concern.
RAO Remedial action objective.
LUCs Land use controls.
O&M Operation and maintenance.

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APPENDIX A

GEOPHYSICAL SURVEY REPORT FOR SITE 38 - RUM POINT LANDFILL

TETRA TECH

TECHNICAL MEMORANDUM

Date: March 8, 2010

To: Joe Rail – NAVFAC Washington
Nate Delong – NAVFAC Washington
Nick Carros – NSF Indian Head
Dennis Orenshaw – EPA
Curtis DeTore – MDE

From: Scott Nesbit - Tetra Tech

Reference: CLEAN Contract No. N62470-08-D-1001
Contract Task Order (CTO) No. JU03

Subject: Geophysical Survey Report for Site 38 (Rum Point Landfill)
Naval Support Facility Indian Head, Maryland

1.0 INTRODUCTION

This technical memorandum has been prepared for the Naval Facilities Engineering Command Washington to present the results of geophysical survey performed by Tetra Tech (Tt) in December 2009 as part of a Feasibility Study (FS) at Site 38 (Rum Point Landfill) at the Naval Support Facility (NSF) Indian Head, Maryland (Figure 1). The geophysical survey was conducted to further define the limits of waste present at the site. The geophysical survey is a follow-up to a 2008 Site Screening Process (SSP) Report completed by Tt.

This memo describes the methods, approach, and results of the geophysical survey to assess the horizontal and vertical extent of the landfill waste.

2.0 SITE DESCRIPTION AND HISTORY

Site 38 is a landfill located in a wooded area off Rum Point Road on the Stump Neck Annex portion of NSF Indian Head. Little is known about the landfill and its history before it became inactive in 1989. A combination of metallic and non-metallic waste is expected in the landfill. A result of the SSP was a plot of an approximate Site Boundary based on previous soil boring information. A geophysical survey was requested to help better estimate the area and volume of the landfill by building on data previously gathered for the site. Part of the landfill's location in the southern end of the site can be recognized by a vegetation-cleared area with many new growth trees in an otherwise older wooded region. Based on visual observation and some limited soil sampling, the landfill was estimated to be approximately 1.5 to 2 acres in size, and believed to be relatively shallow in thickness

The southern end of the site, consisting of a flat grassy portion with many new growth trees, is surrounded to the west, north, and east by steep downward slopes to stream or intermittent stream ravines. The flat grassy portion is bounded on the South by a hill that has an exposed soil face. Metallic and other debris can be seen along the edges of the flat portion and down the slopes in the ravines. The site can be accessed by a vegetation cleared path (presumably the former road leading into the landfill from Rum Point Road). A corrugated metallic drain pipe is present under a portion of this path adjacent to the landfill. The site is mostly dry; the floodplain of the stream to the west of the site was saturated (muddy) during the geophysical survey.

3.0 FIELD PERSONNEL

A Tt Project Geophysicist from the Pittsburgh office (James Coffman) performed the fieldwork from December 15 to December 18, 2009. Tt personnel met the medical, training experience, and educational requirements specified in Chapter 29 Code of Federal Regulations 1910.120.

4.0 EQUIPMENT

The geophysical survey was conducted using two geophysical methods and instruments: a Geonics EM31-MK2 (EM31) electromagnetic unit, and a LaCoste and Romberg Mini-Res electrical resistivity meter. The EM31 was used to evaluate the areal extent of the fill and resistivity soundings were used to evaluate the vertical extent.

The EM31 is a frequency domain electromagnetic (EM) instrument. The EM31 generates electromagnetic fields measured as a function of frequency allowing stark differences in terrain conductivity (or apparent electrical conductivity) to be differentiated. Two measurement components are typically recorded; quadrature-phase (QP) and in-phase (IP). The QP component is sensitive to metallic and non-metallic components of the ground and is commonly referred as the terrain conductivity, while the IP component is predominantly sensitive to metal and is commonly referred to as the metal detection mode. The instrument was operated in vertical dipole mode at hip height which takes earth measurements to nominally about 15 feet below ground surface. This is considered the normal operating mode based on the instrument design. The EM31 was set to acquire data 4 times per second as the operator walked across the site, generating data stations about one foot apart. Individual EM31 data readings can generally be considered to represent a measurement space of about two to three feet laterally from the operator.

The electrical resistivity method directly measures electrical resistance or resistivity (the inverse or opposite of electrical conductivity) of the subsurface using a resistivity meter connected to two electrodes that inject electrical current into the ground and two electrodes that measure the potential (voltage) that results. The electrical resistivity method is considerably slower in acquiring data readings compared with the EM31. The instrument is stationary when collecting data and requires preparation to position the electrodes before readings can be taken. Electrical resistivity provides the advantage of a flexible electrode array that can be used to provide vertical electrical sounding of materials to determine how the apparent electrical resistivity of materials varies with depth. The electrical resistivity survey consisted of soundings at 5 locations. Soundings were performed by deploying 4 stainless steel electrodes equally spaced in a straight line (termed a Wenner array configuration), where multiple electrode spacings were used along each survey line centered on a common mid-point to generate multiple unique data measurements. Data along a given survey line are assumed to be representative of conditions underneath the line (profile data). In theory, the larger the electrode spacing, the deeper the resultant earth electrical resistivity measurement; therefore, vertical changes in resistivity can be noted by collecting data from multiple electrode spacings. Generally, similar electrode spacings between survey lines should measure comparable depths. As a rule of thumb, the median reading depth correlates to ½ the electrode spacing when using the Wenner array.

5.0 DATA COLLECTION

The EM31 survey was conducted using approximately 10-feet spaced meandering survey paths across the site where accessible and where integrated GPS readings could be recorded to position the data. Prior to field acquisition, the equipment was set up according to manufacturer's recommendations (calibrations and operational checks) and this, as well as other pertinent survey information, was recorded in a field logbook. EM31 data were acquired every 0.25 seconds corresponding to an approximate 1-foot interval given the survey walking pace with the instrument.

Five electrical resistivity survey sounding locations were conducted. Four of these locations were positioned on top of the flat portion of the site. One location was on the hill above (south of) the landfill to collect data of native conditions to compare it against the landfill data. Similar electrode spacings between sounding locations were collected where possible to compare the data from each electrode spacing from one survey line to the next. Some of the survey lines included more electrode spacings than others in areas where more space was available.

For each resistivity measurement spacing, multiple readings were taken over approximately a 15 second time period, and an average reading was recorded. Measurement cycles were repeated during the five resistivity survey lines, and repeatable measurements were confirmed.

6.0 RESULTS AND DISCUSSION

The EM31 survey data and interpretation are overlain as an annotated color contour (color shade) map on top of a site plan in Figures 2 and 3, while Table 1 presents the data from the electrical resistivity survey. EM31 data contouring was performed using Geosoft Oasis montaj software (version 7). The color bars included with each of the contour maps provide an indication of the amplitude of the displayed color contours. An Approximate Site Boundary line (solid pink line symbol) is shown on Figures 2 and 3. This line signifies an interpretation of the landfill or site boundary using information collected before the geophysical survey was performed. This boundary was drawn based on soil boring information and visual observation. For purposes of discussion this boundary will be referred to below as the original site boundary.

6.1 EM31

6.1.1 QP Data

Figure 2 shows the EM31 QP component data, also termed apparent electrical conductivity or terrain conductivity data. This component measures response primarily from the apparent electrical conductivity, but is also effected by nearby metal. EM31 data is not unique, in that certain values do not identify certain features. Interpretation is based on relative changes in electrical conductivity, such as when landfill materials are surrounded by native soils, and an interpretation of such features can be made from anomalous data response and some knowledge of a potential reason to explain the anomalous response. Landfill materials do not always create the same apparent electrical conductivity response, and this will depend on how conductive or resistive the materials are that comprise the landfill in relation to the surrounding materials.

Apparent conductivity background (off landfill) readings on the hill south of the site appear to be very close to 0 millisiemens per meter, corresponding to dark blue color contours on Figure 2. Generally, increasing apparent electrical conductivity corresponds to color changes up the color bar shown on Figure 2. More conductive response is evident inside the original site boundary, and overall EM31 apparent conductivity readings are in good agreement (data trends agree) with actual electrical resistivity measurements shown in Table 1.

It is common that hill top terrain conductivity readings show a low conductivity reading in comparison to the valley, with a transitional zone between the two areas. This trend can be seen on Figure 2 and is typically a result of moisture content. Although local anomalies are apparent on the slope within the suspected landfill boundary, the landfill is generally difficult to discern based on the terrain conductivity alone. This could indicate that the landfill either contains or is covered with native materials that do not provide a distinct change.

6.1.2 IP Data

Figure 3 shows the EM31 IP component data. This component measures primarily the response from buried and surface metal located near the instrument. The contour map on this figure shows apparent background (off landfill) readings to be the orange color shades corresponding to values of approximately 1 part per thousand. Metal concentrations are evident in the green to blue (down the color bar) and red to pink (up the color bar) color contours, and these concentrations are present along the edge of the flat southern portion of the site, and in some cases down the slopes. Highest instrument response levels correspond to the bottom and top of the color bar shown on Figure 3 (high negative and high positive data values).

The highest concentrations of anomalies appear on the northwest slope. Anomalous instrument response attributed to a metallic drainage culvert along the path leading into the landfill is readily apparent at the eastern edge of the surveyed area (drainage culvert is annotated on Figures 2 and 3). In general the IP data appears to be a better indicator of the landfill boundaries than the terrain conductivity.

Monitoring wells were present in the survey area and resultant anomalies are evident near some of the wells. The presence or absence of buried metal at or near (within about 5 feet of) such locations cannot be determined from the EM31 data alone.

6.2 ELECTRICAL RESISTIVITY

Similar to EM31 data, electrical resistivity data are also not unique (certain values do not identify certain features); however, data can be interpreted using data responses in combination with possible cause(s) that could explain them. Each of the resistivity soundings within the suspected landfill boundary supports a high resistivity layer (205-260 ohm-meters) overlying a lower restivity zone (22-34 ohm-meters), with a transitional zone in between (which may be the result of measurement). The background location, sounding line 5, indicated a considerable higher surface resistivity (1045-1458 ohm-meters) than the other areas. Based on the interpreted fill area identified in Figure 3 and the results of the terrain conductivity, it appears that landfill is difficult to differentiate based on the electrical properties. However, if the low resistivity seen at depth is believed to be native materials, the maximum thickness of the landfill would be expected to be 8 to 16 feet using the ½ spacing depth.

7.0 CONCLUSION

Interpretations presented in this report were made taking into account the geophysical and other available supporting data (i.e. soil borings and visual evidence of waste) to as much as possible help with estimating the area and relative volume of the landfill. In general the data indicate that the fill was predominantly placed on the slope and which confirmed the predicted limits of waste disposal at the site. Because geophysical data are considered to be non-unique and somewhat interpretive, test pits and/or exploratory borings are recommended to check the interpretations presented in this report.

TABLE 1

CALCULATED ELECTRICAL RESISTIVITIES
SITE 38 – RUM POINT LANDFILL
NAVAL SUPPORT FACILITY
INDIAN HEAD, MARYLAND

Sounding Line 1

Electrode Spacing (feet)	Resistance (ohms)	Resistivity (ohm-feet)	Resistivity (ohm-meters)
16	7.75	779.1149781	237.4626571
32	2.37	476.5167737	145.2352251
64	0.28	112.5946807	34.317184

Sounding Line 2

Electrode Spacing (feet)	Resistance (ohms)	Resistivity (ohm-feet)	Resistivity (ohm-meters)
16	4.25	427.2566009	130.2214571
32	0.97	195.0300719	59.44226514
64	0.2	80.42477193	24.51227429
80	0.15	75.39822369	22.98025714

Sounding Line 3

Electrode Spacing (feet)	Resistance (ohms)	Resistivity (ohm-feet)	Resistivity (ohm-meters)
16	8.41	845.4654149	257.6852834
32	1.47	295.5610368	90.082608
64	0.24	96.50972632	29.41472914
80	0.17	85.45132018	26.04429143
100	0.14	87.9645943	26.8103

Sounding Line 4

Electrode Spacing (feet)	Resistance (ohms)	Resistivity (ohm-feet)	Resistivity (ohm-meters)
16	6.71	674.5627746	205.5967006
32	1.63	327.7309456	99.88751771
64	0.24	96.50972632	29.41472914

Sounding Line 5

Electrode Spacing (feet)	Resistance (ohms)	Resistivity (ohm-feet)	Resistivity (ohm-meters)
16	47.6	4785.27393	1458.48032
32	22.2	4463.574842	1360.431223
64	8.53	3430.116523	1045.448498
80	4.99	2508.247575	764.4765543
100	2.19	1376.017582	419.3896929

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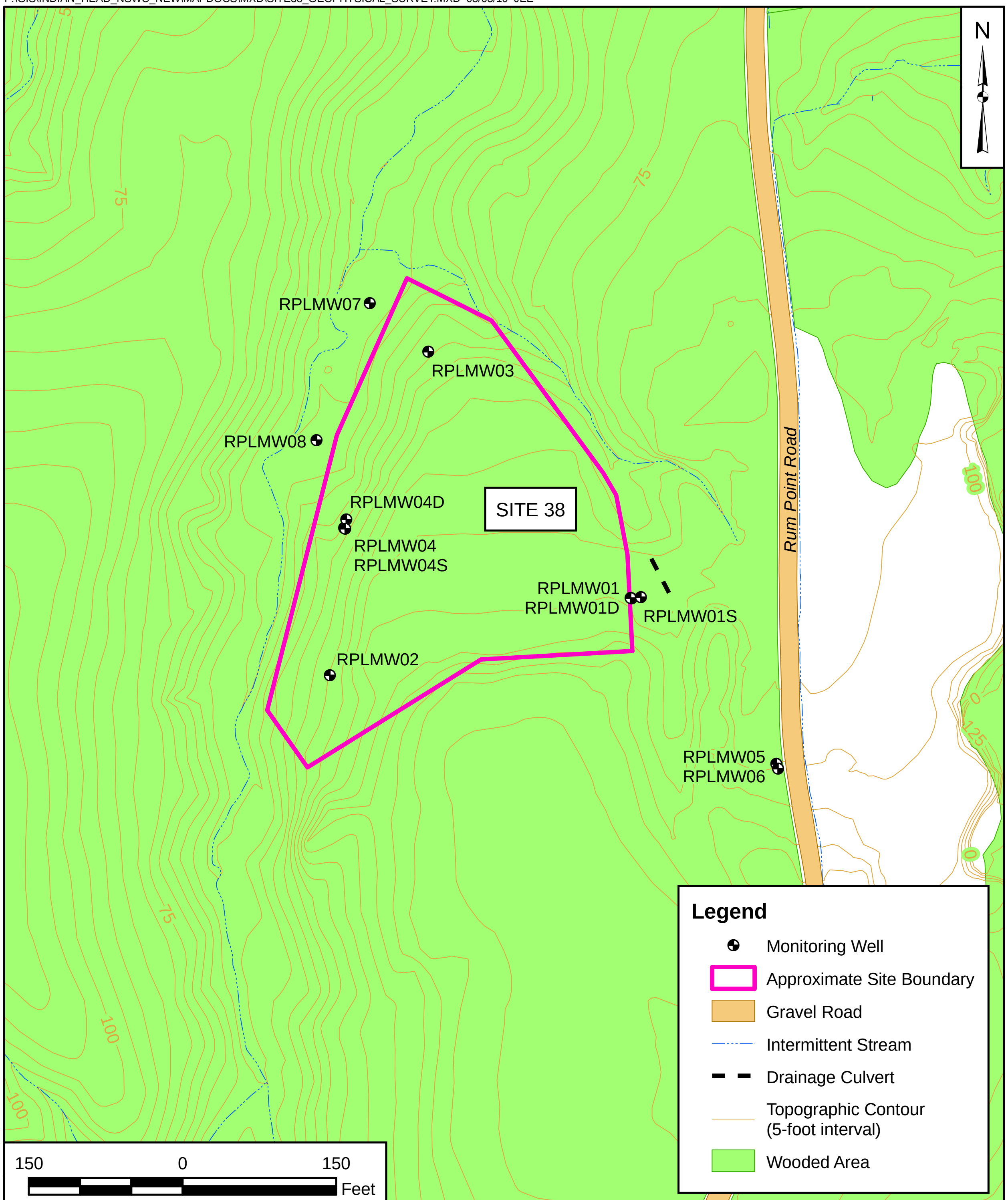

DRAWN BY J. ENGLISH	DATE 09/25/09	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62470-08-D-1001	OWNER NO. CTO JU03
CHECKED BY J. COFFMAN	DATE 03/03/10	SITE LOCATION SITE 38 - RUM POINT LANDFILL NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY	DATE
COST/SCHEDULE AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1	REV 0

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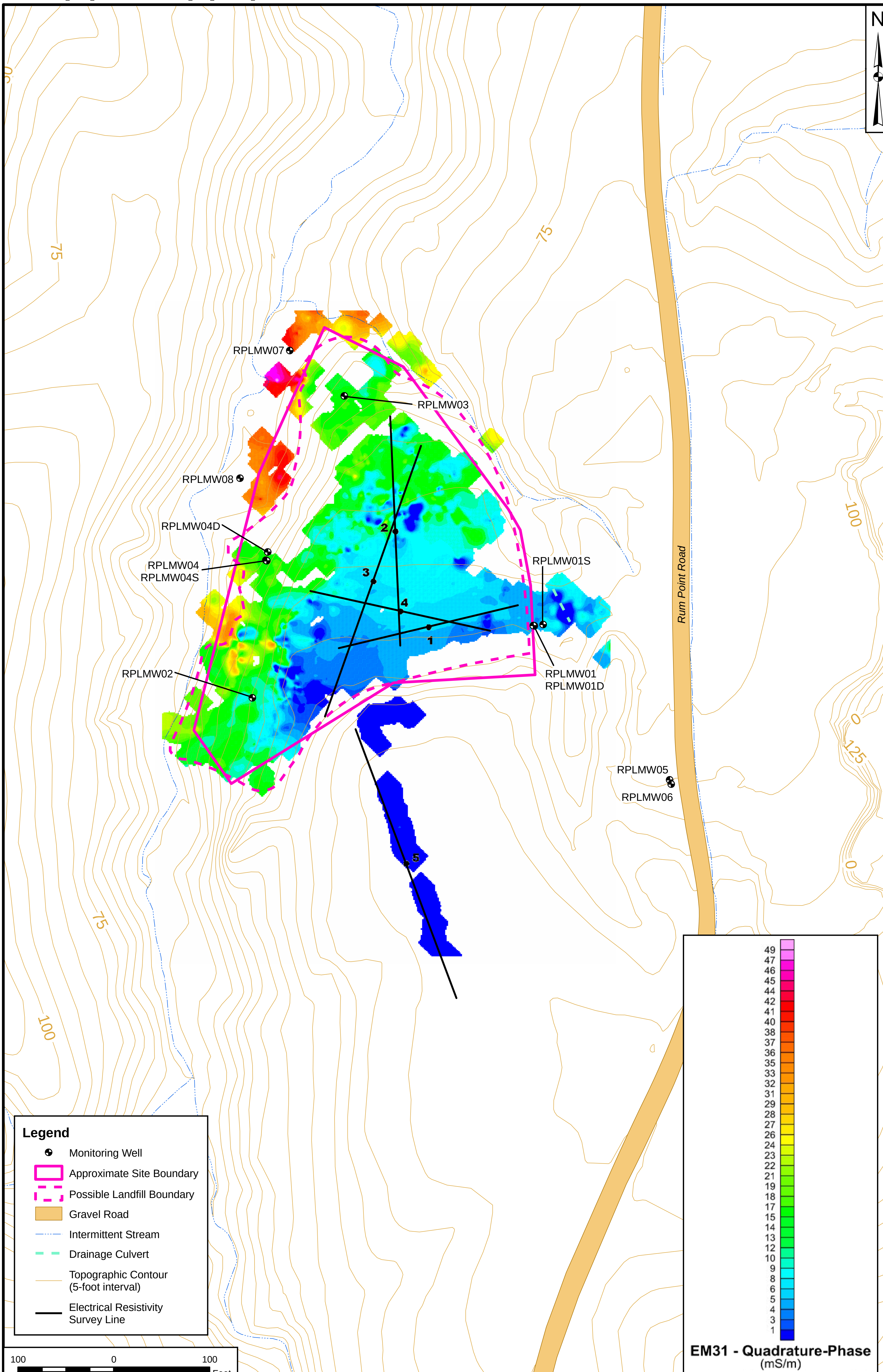
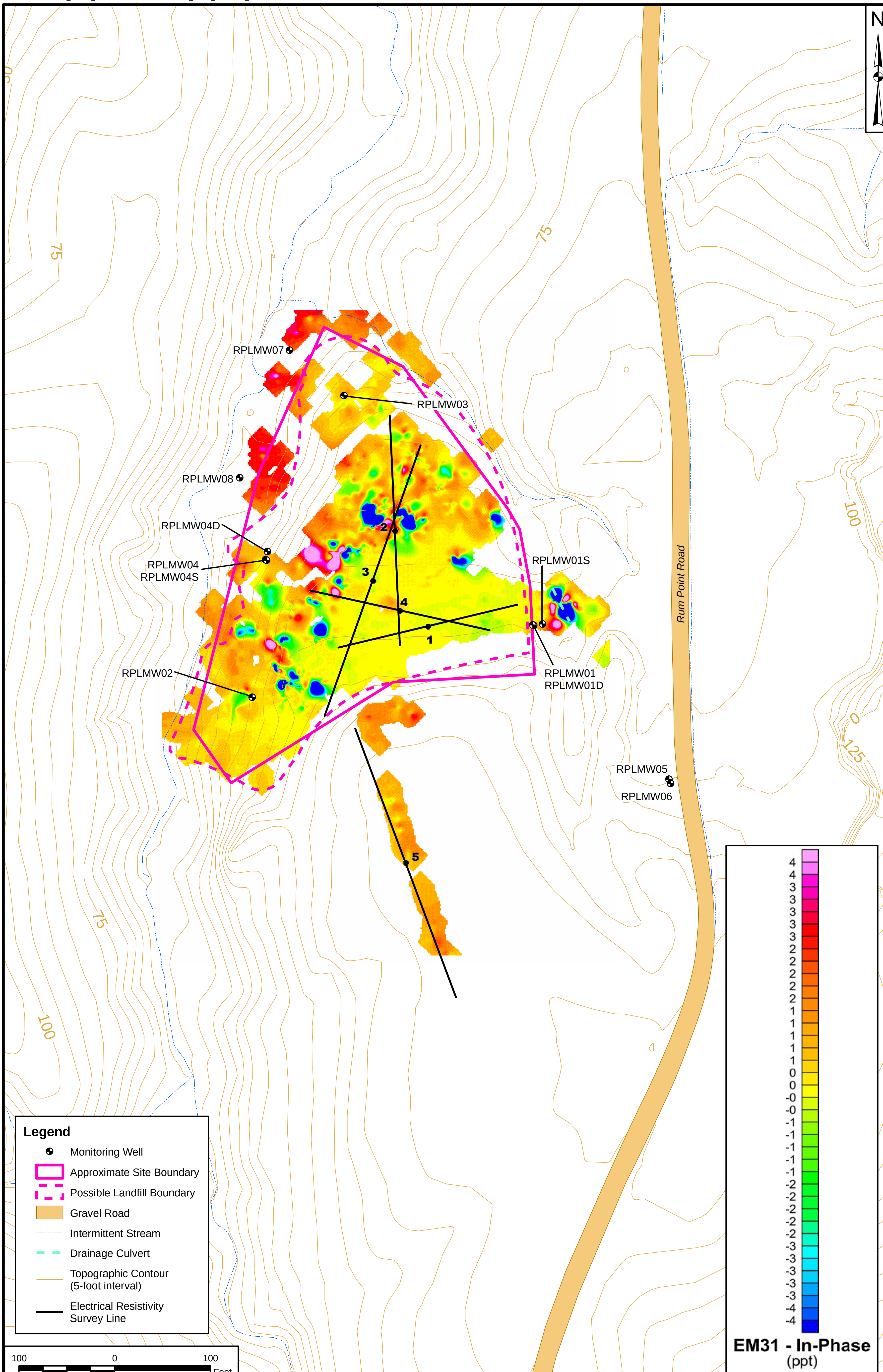


DRAWN BY: J. ENGLISH — DATE: 12/29/09	NAVFAC	EM31 APPARENT CONDUCTIVITY	CONTRACT NUMBER: ___
CHECKED BY: J. COFFMAN — DATE: 03/03/10		COLOR CONTOUR MAP AND INTERPRETATION	APPROVED BY: ___ — DATE: ___
REVISED BY: ___ — DATE: ___		SITE 38 - RUM POINT LANDFILL	APPROVED BY: ___ — DATE: ___
SCALE: AS NOTED		NAVAL SUPPORT FACILITY INDIAN HEAD	FIGURE NO.: FIGURE 2 — REV: 0
		INDIAN HEAD, MARYLAND	

P:\GIS\INDIANHEAD_NSWC_NEW\MAPDOCS\MXD\SITE38_EM31_INPHASE_1117.MXD 03/03/10 JEE



DRAWN BY: J. ENGLISH — DATE: 01/05/10	NAVFAC	EM31 IN-PHASE COMPONENT	CONTRACT NUMBER: ____
CHECKED BY: J. COFFMAN — DATE: 03/03/10		COLOR CONTOUR MAP AND INTERPRETATION	APPROVED BY: ____ DATE: ____
REVISED BY: ____ — DATE: ____		SITE 38 - RUM POINT LANDFILL	APPROVED BY: ____ DATE: ____
SCALE: AS NOTED		NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	FIGURE NO.: FIGURE 3 — REV: 0

APPENDIX B

TEST TRENCHING DATA

TETRA TECH

MRP FF.2

DAILY MEC ACTIVITY LOG

Facility/Location: **Naval support Facility Indian Head, Maryland**

Site(s): **Site 38-Rum Point Landfill**

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/14/12**
PROJECT NO: 112GN2144	**TASK CODES**: 0000.0515

SUMMARY OF DAILY PROGRESS: (Update Definable Feature of Work – Worksheet 12)

Mobilization/Site Preparation: Syd Rodgers, Pete Dummitt MOB 5/12/12, Norm Piper, Nick Brantley, Frank Loney MOB 5/13/12. Site walk was conducted by Navy POC and the entire team to identify boundaries of site and where the Navy suggests we excavate each trench.

Site Survey: N/A

Vegetation Management: Brush cutting was accomplished to gain access to the site, IVS location, and the first selected trenching location.

GPS Positional Data: Known points were identified and the GPS verification was completed

IVS: Was established and the seed items were logged with the hand held GPS

Detector Aided Surface Surveys: Was conducted at the location where trench #1 will be dug.

Target Reacquisition: N/A

Intrusive Operation: N/A

Donor Explosives Handling/Storage: N/A

MPPEH Management (Certification): N/A

MPPEH Management (Disposal): N/A

Demobilization: N/A

Other: N/A

LIST OF MEC ITEMS ID, MPPEH ITEM ID, MDAS, OR NONE
(for documentation see MEC/MPPEH/MDAS Tracking Logs for added details)**:**
No MEC,MPPEH,MDAS was recovered today

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	Date: 5/14/12

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

07:00 The UXO team reported to Pass and ID section at the Stump Neck annex to obtain our daily pass. With this accomplished we traveled to the Main Side to attend a meeting with the Navy POC and to read and go over the Work Plan and sign required documentation. The team then caravaned back to Stump Neck where site 38 is located. Upon our arrival the excavator that was requisitioned arrived and we took possession of it and moved it to the site location. IH Stump Neck Guards will provide entry access at the beginning of each day and secure the entrance gate at the end of daily operations. Base POC Nick Carros contacted the base Fire Dept. to notify them of the beginning of operations. Per the Fire Dept. daily notification will not be required.

The team went about setting up the site for operations. The IVS was located, a detector aided surface survey performed, and the IVS was installed using anomaly avoidance, the operator for the excavator went through his paces to get accustomed to the particular unit (not digging), personnel were sent on a mission to rent the required power tools (vegetation management) and purchase the safety equipment needed to operate this equipment. Bravo flags were installed and road barriers were put into place for security. No trenching operations will commence until the MPPEH certification authorization form has been forwarded. Trench #1 was located by the SUXOS. The area was cleared with brush cutting equipment. Down hole magnetometer was checked for operational status, and the GPS was verified against known monuments for accuracy. (all passed)

On 5/15/12 after the daily safety briefing and during the NOSSA Audit part of the team will transport the personnel blast shield from Main Side to Site 38 and place into position for trenching Trench #1.

18:00 UXO team secured for the day.

The MPPEH certification authorization was received today at 16:45. Trenching operations will commence tomorrow.

IMPORTANT PHONE CALLS/DECISIONS: N/A

FIELD TASK MODIFICATIONS: N/A

WEATHER CONDITIONS: Showers early becoming steadier. Thunder possible. High 69F. Winds SSE@5-10mph. Rain 70%. Rainfall near half inch.

VISITORS ON SITE: Nicholas Carros (Base POC), Scott Nesbit (Tetra Tech PM), Small Rodent Survey Personnel

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/14/12**
PERSONNEL ON SITE: Syd Rodgers (SUXOS), Pete Dummitt (QC/Safety) Nick Brantley (Tech II),Frank Loney (Tech I), Norm Piper (Site Manager)	
SIGNATURE: Syd Rodgers	**DATE: 5/14/12**

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/15/12**
PROJECT NO: 112GN2144	**TASK CODES**: 0000.0515

SUMMARY OF DAILY PROGRESS: (Update Definable Feature of Work – Worksheet 12)

Mobilization/Site Preparation: N/A

Site Survey: N/A

Vegetation Management: N/A

GPS Positional Data: Known points were identified and the GPS verification was completed

IVS: Instruments were checked at the IVS and all passed

Detector Aided Surface Surveys: Was conducted at each trench location prior to any digging efforts

Target Reacquisition: N/A

Intrusive Operation: Trenches were dug at 4 different locations to varied depths. A magnetometer was used at each two foot lift.

Donor Explosives Handling/Storage: N/A

MPPEH Management (Certification): See Below

MPPEH Management (Disposal): N/A

Demobilization: N/A

Other: N/A

LIST OF MEC ITEMS ID, MPPEH ITEM ID, MDAS, OR NONE
(for documentation see MEC/MPPEH/MDAS Tracking Logs for added details)**:**

- **(1) 5 inch projectile base. (Located during 2011 trenching operation.) MDAS**
- **(1) Ammo Can (Empty) (Located during 2011 trenching operations.) MDAS**

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	Date: 5/15/12

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

07:00 UXO Team arrived at Site amid heavy rain. The team checked in at Security to obtain a new Day Pass for Indian Head, Stump Neck annex.

After instruments check, and vehicle operational check list was completed part of the team departed to Main Side to pick up a blast shield.

Team returned to the Site and commenced trenching operations.

MDAS items located during previous efforts were secured in the MDAS drum.

Tetra Tech PM and Navy RPM visited the site and viewed operations at separate times during the day.

Trench #1 4' (W) x5' (D) x11'(L), 3.5' to native soil, Rebar and asphalt was found in the spoils

Trench #2 4' (W) x8.5' (D) x10' (L), 4.5' to native soil, Pipe /Scrap Metal, was found in the spoils

Trench #3 4' (W) x4' (D) x10' (L), 2.0 to virgin soil, Asphalt, Scrap Metal, rubber hose was found in spoils

Trench #4 2' (W) x3' (D) x11.6 (L), 0' to virgin soil, small piece of scrap metal just below the surface.

UXO team secured equipment for the day.

17:00 UXO Team departed site

IMPORTANT PHONE CALLS/DECISIONS: N/A

FIELD TASK MODIFICATIONS: N/A

WEATHER CONDITIONS: Variable clouds with showers and scattered thunderstorms. High 78F. Winds S@5-10mph. Rain 60%

VISITORS ON SITE: Joe Rail (Navy RPM), Scott Nesbit, Small Mammal Surveyors.

PERSONNEL ON SITE: Syd Rodgers (SUXOS), Pete Dummitt (QC/Safety) Nick Brantley (Tech II),Frank Loney (Tech I), Norm Piper (Site Manager)

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/15/12**
SIGNATURE: Syd Rodgers	**DATE: 5/15/12**

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: **Naval support Facility Indian Head, Maryland**

Site(s): **Site 38-Rum Point Landfill**

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/16/12**
PROJECT NO: 112GN2144	**TASK CODES**: 0000.0515

SUMMARY OF DAILY PROGRESS: (Update Definable Feature of Work – Worksheet 12)

Mobilization/Site Preparation: N/A

Site Survey: N/A

Vegetation Management: N/A

GPS Positional Data: Known points were identified and the GPS verification was completed

IVS: Instruments were checked at the IVS and all passed

Detector Aided Surface Surveys: Was conducted at each trench location prior to any digging efforts

Target Reacquisition: N/A

Intrusive Operation: Three trenches were investigated today

Donor Explosives Handling/Storage: N/A

MPPEH Management (Certification): N/A

MPPEH Management (Disposal): N/A

Demobilization: Norm Piper (Site Manager)

Other: N/A

LIST OF MEC ITEMS ID, MPPEH ITEM ID, MDAS, OR NONE
(for documentation see MEC/MPPEH/MDAS Tracking Logs for added details)**:**
No MEC,MPPEH,MDAS was recovered today

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	Date: 5/16/12

07:00 UXO team assembled at the Pass and ID office, (Stump Neck Branch), to obtain our daily on site passes.

NOSSA (Ms. Kathy Garcia) was on site at 07:00 to start her NOSSA Audit of our operation. Ms. Garcia spent most of her time with Mr. Pete Dummit (QC/Safety Specialist) checking our Work Plan, Certifications, and other documents that pertained to this project.

After the document phase was completed Mr. Joe Rail (Navy RPM) arrived on site. Mr. Rail and Ms. Garcia observed the excavation of two trenches standing behind the blast shield with the observing UXO Techs. Both trenches they observed came up empty of any ordnance related materials also the trenches were almost completely void of any trash at all. All that was recovered today was a couple small sections of pipe and a short section of banding material.

Ms. Garcia conducted an out briefing of her findings. Only three minor infractions. #1. New wording on the DD 1348-1 for certifying the MDAS, (an OP-5 change). #2 If all items in the MDAS container cannot fit on the DD 1348-1 a statement on the 1348 should state (see additional sheet for inventory). #3 It is common practice at Tetra Tech that all personnel must read and sign a statement that they have read and understand the contents of the Work Plan and will comply. This was done but there was nothing in the Work Plan that it is a requirement to do this.

Trenching this afternoon under the supervision of the SUXOS was used as a training tool, the Tech 1 (Frank Loney) dug the trench and a Tech II (Nick Brantley) filled the trench back in.

Trench #5 2' (W) x3.7' (D) x10.5'(L), 6" to native soil, nothing recovered in spoils

Trench #6 2' (W) x3.9' (D) x11' (L), all native soil, nothing recovered in the spoils

Trench #7 2' (W) x7' (D) x10' (L), 1.0' to virgin soil, Asphalt, Rebar, steel pipe.

17:00 UXO Team departed the site.

IMPORTANT PHONE CALLS/DECISIONS: N/A

FIELD TASK MODIFICATIONS: N/A

WEATHER CONDITIONS: Partly cloudy. Stray PM thunderstorm possible. High 84F. Winds SW@5-10mph.

VISITORS ON SITE: Joe Railings (Navy RPM), Kathy Garcia (NOSSA), Mark Brucirick (ESA)

PERSONNEL ON SITE: Syd Rodgers (SUXOS), Pete Dummitt (QC/Safety) Nick Brantley (Tech II),Frank Loney (Tech I)

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/16/12**
SIGNATURE: Syd Rodgers	**DATE: 5/16/12**

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/17/12**
PROJECT NO: 112GN2144	**TASK CODES**: 0000.0515

SUMMARY OF DAILY PROGRESS: (Update Definable Feature of Work – Worksheet 12)

Mobilization/Site Preparation: N/A

Site Survey: N/A

Vegetation Management: N/A

GPS Positional Data: Known points were identified and the GPS verification was completed

IVS: Instruments were checked at the IVS and all passed

Detector Aided Surface Surveys: Was conducted at each trench location prior to any digging efforts

Target Reacquisition: N/A

Intrusive Operation: Three trenches were excavated today #8,#9,#10

Donor Explosives Handling/Storage: N/A

MPPEH Management (Certification): N/A

MPPEH Management (Disposal): N/A

Demobilization: N/A

Other: N/A

LIST OF MEC ITEMS ID, MPPEH ITEM ID, MDAS, OR NONE
(for documentation see MEC/MPPEH/MDAS Tracking Logs for added details)**:**
No MEC,MPPEH,MDAS was recovered today

TETRA TECH
MRP FF.2
DAILY MEC ACTIVITY LOG

Facility/Location: Naval support Facility Indian Head, Maryland

Site(s): Site 38-Rum Point Landfill

FIELD ACTIVITY SUBJECT: MEC Time Critical Removal Action	**Date: 5/17/12**

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

07:00 UXO team assembled at the Pass and ID office, (Stump Neck Branch), to obtain our daily on site passes.

Team proceeded to Site 38 to do operational checks on instruments and excavator. (all passed)

With checks completed the SUXOS selected three locations for Trenches #8, #9 and #10.

Trench #8 The trench was dug 10’ (L)x6.5’ (D)x2’ (W) 3” down we encountered native soil, no evidence of any scrap was encountered.

Trench #9 The trench was dug 10’ (L)x5.5’ (D)x2’ (W) Native soil was encountered at 2’, spoils produced limited rebar and a piece of pipe.

Trench #10 The trench was dug 10’ (L) x9’ (D) x2’ (W) Native soil was encountered at approximately 7.5’. This trench is definitely part of a trash pit area; we encountered numerous rail road ties, an electrical box, scrap metal, a plastic pail, a collection of shag carpets and other construction debris.

A team member was dispatched to purchase bales of hay and grass seed for seeding the area when all excavation has been completed.

17:00 Team secured for the day.

IMPORTANT PHONE CALLS/DECISIONS: N/A

FIELD TASK MODIFICATIONS: N/A

WEATHER CONDITIONS: Sun and clouds mixed. High 74F. Winds NNE@10-15mph

VISITORS ON SITE: N/A

PERSONNEL ON SITE: Syd Rodgers (SUXOS), Pete Dummitt (QC/Safety) Nick Brantley (Tech II),Frank Loney (Tech I)

SIGNATURE: Syd Rodgers	**DATE:** 5/17/12


05/17/2012

Test Trench 2

Test Trench 5


Test Trench 9


Test Trench 10

APPENDIX C

ENVIRONMENTAL FOOTPRINT EVALUATION

APPENDIX C-1 ENVIRONMENTAL FOOTPRINT REPORT

APPENDIX C

Environmental Footprint Evaluation
Feasibility Study
Site 38 – Rum Point Landfill
Naval Support Facility – Indian Head
Indian Head, Maryland
July 2012

OBJECTIVE

This Environmental Footprint Evaluation of remedial alternatives is provided as an Appendix to the Feasibility Study (FS) for Site 38 – Rum Point Landfill located at the Naval Air Support Facility Indian Head located in Indian Head, MD. The purpose of the footprint evaluation is to assess the environmental impacts of the two remedial alternatives using the metrics of greenhouse gas (GHG) and criteria pollutant emissions, energy use, water consumption, and worker safety. The results of this footprint evaluation are intended to provide additional information for consideration during remedy selection, design, and to enhance the understanding of the environmental impacts throughout the remedy life-cycle for each of the proposed alternatives.

POLICY BACKGROUND

Department of Defense (DOD) and Navy policies require continual optimization of remedies in every phase from remedy selection through site closeout (NAVFAC, 2010a).

In January 2007, Executive Order 13423 set targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, etc. In October 2009, Executive Order 13514 was issued, which reinforced these sustainability requirements and established specific goals for federal agencies to meet by 2020.

In August 2009 DOD issued a policy for "Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program." The DOD policy and related Navy guidance state that opportunities to increase sustainability should be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout). In response to this policy, the Department of the Navy (DON) issued an updated Navy Guidance for "Optimizing Remedy Evaluation, Selection, and Design" (NAVFAC, 2010), which includes environmental footprint evaluations as part of the traditional DON optimization review process for remedy selection, design, and remedial action operation. In August 2010, the Naval Facilities Engineering Command (NAVFAC) issued policy requiring use of the SiteWise™ tool to perform environmental impact reviews as part of all Feasibility Studies. As such, this environmental footprint evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of reducing the environmental impact of remedial action at Site 38, Naval Support Facility Indian Head.

Applying the DON optimization concepts with an environmental footprint evaluation within the remedy selection and design phases allows for the following benefits:

- Determining factors in each remedial alternative with the greatest environmental impacts and gathering insight into how to reduce these impacts;
- Evaluating remedial alternatives with optimized or reduced environmental footprints in conjunction with other selection criteria;
- Designing and implementing a more robust remedy while balancing the impact to the environment; and
- Ensuring efficient, cost-effective and sustainable site closeout.

EVALUATION TOOLS

This evaluation was performed using a hybrid model of the Navy's SiteWise™ tool supplemented with Tetra Tech developed model as appropriate for some site-specific items.

SiteWise™ is a life-cycle footprint assessment tool developed jointly by the U.S. Navy, U.S. Army Corps of Engineers (USACE), and Battelle. SiteWise™ assesses the environmental footprint of a remedial alternative/technology using a consistent set of metrics. The assessment is conducted using a building block approach, where each remedial alternative is first broken down into modules that follow the phases for most remedial actions, including remedial investigation (RI), remedial action construction (RA-C), remedial action operation (RA-O), and long-term monitoring (LTM). Once broken down by remedial phase, the footprint of each phase is calculated. The phase-specific footprints are then combined to estimate the overall footprint of the remedial alternative. This building block approach reduces redundancy in the footprint assessment and facilitates the identification of specific impact drivers that contribute to the environmental footprint. The inputs that need to be considered include (1) production of material required by the activity; (2) transportation of the required materials to the site, transportation of personnel; (3) all site activities to be performed; and (4) management of the waste produced by the activity.

Green Sustainable Remediation Tool (GSRx) developed by Teatra Tech, Inc. builds off of SiteWise™ and allows for a flexible, detailed analysis, particularly for materials and equipment use. GSRx was used to account for materials and activities not readily input into SiteWise™ and where equipment usage assumptions built into SiteWise™ were not consistent with site-specific requirements.

ENVIRONMENTAL FOOTPRINT EVALUATION FRAMEWORK AND LIMITATIONS

The environmental footprint evaluation performed for the FS of Site 38 at Naval Support Facility Indian Head considered life-cycle quantitative metrics for global warming potential (through greenhouse gas emissions), criteria air pollutant emissions (through NO_X, SO_X and PM_{10} emissions), energy consumption, water usage, and worker safety.

Life cycle impacts were calculated for energy consumption, emissions of GHG (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) and criteria pollutants (nitrogen oxides [NO_x], sulfur oxides [SO_x] and particulate matter [PM_{10}]), water usage, and energy consumption, and worker safety.

Life cycle inventory inputs in SiteWise™ were divided into four categories – 1) materials production; 2) transportation of personnel, materials and equipment; 3) equipment use and miscellaneous; and 4) residual handling and disposal. Cost estimates from the RI/FS and design calculations were used as a basis for inventory quantities and related assumptions. Emission factors, energy consumption, and water usage data were correlated to material quantities, equipment, transportation distances, and installation time frames in order to calculate life-cycle emissions, energy consumption, water usage, and worker safety. Default SiteWise™ emission, energy usage, water consumption, and worker fatality and accident risk factors were utilized.

Although GSRx was used to minimize limitations resulting within SiteWise™, elimination of all limitations was not possible while using a hybrid model of SiteWise™ and GSRx. For example, several materials and construction equipment inventoried were input into GSRx and these impacts were incorporated into SiteWise™ within the “Equipment Use and Miscellaneous” sector. This sector in SiteWise™ does not differentiate into the specific equipment usage or material consumption items that are input in GSRx, but rather are considered miscellaneous items. However, impact drivers for items input in GSRx can be identified and evaluated directly within the respective GSRx evaluation and output summary sheets. In addition, worker safety results in general do not include worker safety related to equipment usage that was input within GSRx because GSRx was not developed to evaluate worker safety.

EVALUATION RESULTS

The following are the alternatives that were analyzed with SiteWise™ and GSRx for the Site 38 Naval Support Facility Indian Head FS:

- Alternative 1: Capping with Land Use Controls
- Alternative 2: Landfill Removal with Land Use Controls

The following sections summarize the relative environmental impacts and primary impact drivers for the four alternatives and their respective metrics. In addition, the attachment includes the inventory and output sheets that were used for the SiteWise™/GSRx hybrid model. An evaluation of SiteWise™ and GSRx output summary sheets and related figures included in the footprint evaluation attachments (Appendix C-2 and C-3), provides detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Table C1.

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure C1 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the two alternatives evaluated and the y-axis represents the GHG emissions in metric tons of CO_2e.

The total amount of GHG emissions from Alternative 1 is 303.33 metric ton of CO_2e. The main contributor the GHG emission is the production of 3471 cubic yards (CY) of borrow soil. This specific activity contributes 94.14 metric ton of CO_2e, corresponding to approximately 31 percent of the total GHG emissions. Production of 150,000 square feet (sf) of HDPE geotextile is the activity with the second highest contribution to GHG emissions. The amount of GHG emissions resulting from the production of HDPE is 81.82 metric ton of CO_2e, corresponding to approximately 27 percent of the total GHG emissions for this Alternative. The activity with the third highest contribution to GHG emissions is the transportation of materials. Transportation of materials releases to the atmosphere 30.43 metric ton of CO_2e, which corresponds to approximately ten percent of the total GHG emissions.

Alternative 2 releases a total of 240.32 metric ton of CO_2e. The main contributor to the GHG emissions is the residual handling operations, where 6150 ton of materials are transported and disposed. The amount of GHG emissions resulting from this activity is 118.54 metric ton of CO_2e, which corresponds to approximately 49.3 percent of the total GHG emissions for this Alternative. The production of 810 CY of borrow soil is the activity with the second highest contribution to GHG emissions. The production of borrow soil releases to the atmosphere 25.35 metric ton of CO_2e, corresponding to 10.5 percent of the total GHG emissions for Alternative 2. The activity with the third highest contribution to GHG emissions is the use of the 200 hp dozer, which is in use for 224 hours. The use of the dozer releases 24.61 metric ton of CO_2e, which corresponds to approximately 10.2 percent of the total GHG emissions for Alternative 2.

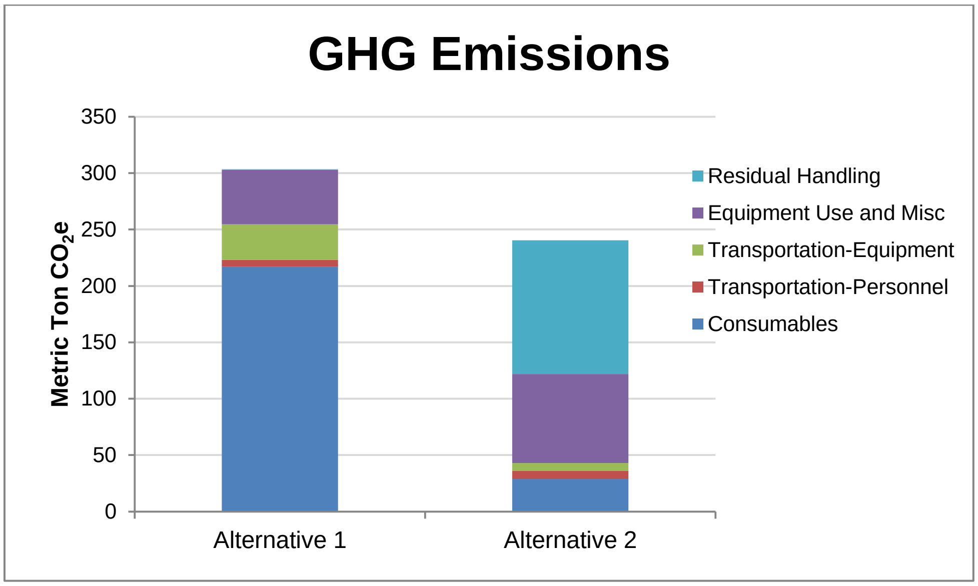


Figure C1: GHG Emissions for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Figure C2 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the GHG emissions (y-axis).

The total amount of GHG emissions for Alternative 1 is 303.33 metric ton of CO_2e. The activity group with the highest contribution to these emissions is the production of materials. The amount of GHG emissions resulting from the production of materials sector is 217.02 metric ton on CO_2e, corresponding to approximately 71.5 percent of the total GHG emissions resulting from Alternative 1. The activity sector with the second highest contribution to GHG emissions is the equipment use and miscellaneous. Equipment use and miscellaneous contributes with 48.23 metric ton of CO_2e, corresponding to approximately 15.9 percent of the total GHG emissions resulting from Alternative 1. Transportation of equipment and materials is the activity sector with the third highest contribution of GHG emissions.

Transportation of equipment and materials contributes 31.53 metric ton of CO_2e, which corresponds to 10.4 percent of the total GHG emissions from Alternative 1.

The total amount of GHG emissions resulting from the activities that take place during Alternative 2 is 240.32 metric ton of CO_2e. The activity sector with the highest contribution to GHG emissions is the residual handling operations. Residual handling operations contribute with 118.54 metric ton of CO_2e, which corresponds to 49.3 percent of the total GHG emissions. Equipment use and miscellaneous is the activity sector that has the second highest contribution to GHG emissions. Equipment use and miscellaneous emits 78.69 metric ton of CO_2e, which corresponds to approximately 32.7 percent of the total GHG emissions resulting from Alternative 2. The activity sector with the third highest contribution to GHG emissions is the production of materials. Production of materials contributes with approximately 12 percent of the total GHG emissions, corresponding to 28.75 metric ton of CO_2e.

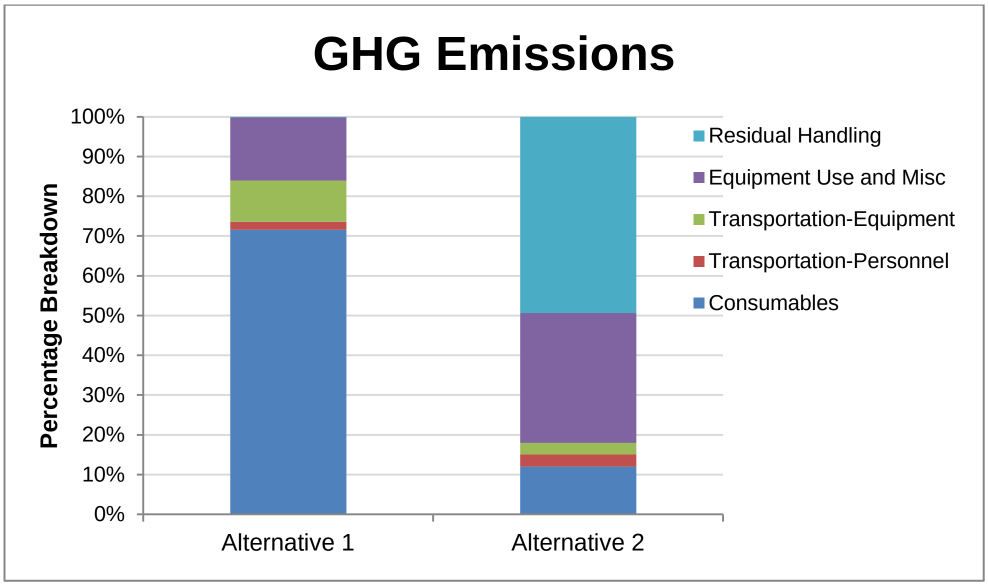


Figure C2: GHG Emissions percentage breakdown for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Criteria Pollutant Emissions

NO_X

Figure C3 shows the breakdown of the NO_X emissions for the two alternatives evaluated. The x–axis of this figure represents Alternatives 1 and 2; the y-axis represents the NO_X emissions in metric tons.

The total amount of NO_X emissions from Alternative 1 is 2.85×10^{-1} metric ton. The main contributor the NO_X emissions is the use of the 200 hp dozer, which is in operation 192 hours. This specific activity contributes 1.30×10^{-1} metric ton of NO_X, corresponding to approximately 45.6 percent of the total NO_X emissions. The use of the 240 hp compactor for 160 hours is the activity with the second highest contribution. The amount of NO_X emissions resulting from using the compactor is 8.69×10^{-2} metric ton, corresponding to approximately 30.5 percent of the total NO_X emissions for this Alternative. The activity with the third highest contribution to NO_X emissions is the use of laboratory analytical services. The use of the laboratory services releases 4.9×10^{-2} metric ton of NO_X which corresponds to approximately 17.2 percent of the total NO_X emissions for Alternative 1.

Alternative 2 releases a total of 3.26×10^{-1} metric ton of NO_X. The main contributor to the NO_X emissions is the residual handling operations, where 6150 ton of materials are transported and disposed of. The amount of NO_X emissions resulting from this activity is 4.06×10^{-1} metric ton, which corresponds to approximately 46.6 percent of the total NO_X emissions for this Alternative. The use of the 200 hp dozer, which is in operation for 224 hours, is the activity with the second highest contribution to NO_X emissions. The use of the 200 hp dozer releases to the atmosphere 1.51×10^{-1} metric ton of NO_X, corresponding to 17.4 percent of the total NO_X emissions for Alternative 2. The activity with the third highest contribution to NO_X emissions is the use of the dump trucks. The use of the dump trucks releases 9.43×10^{-2} metric ton of NO_X, which corresponds to 10.8 percent of the total NO_X emissions for Alternative 2.

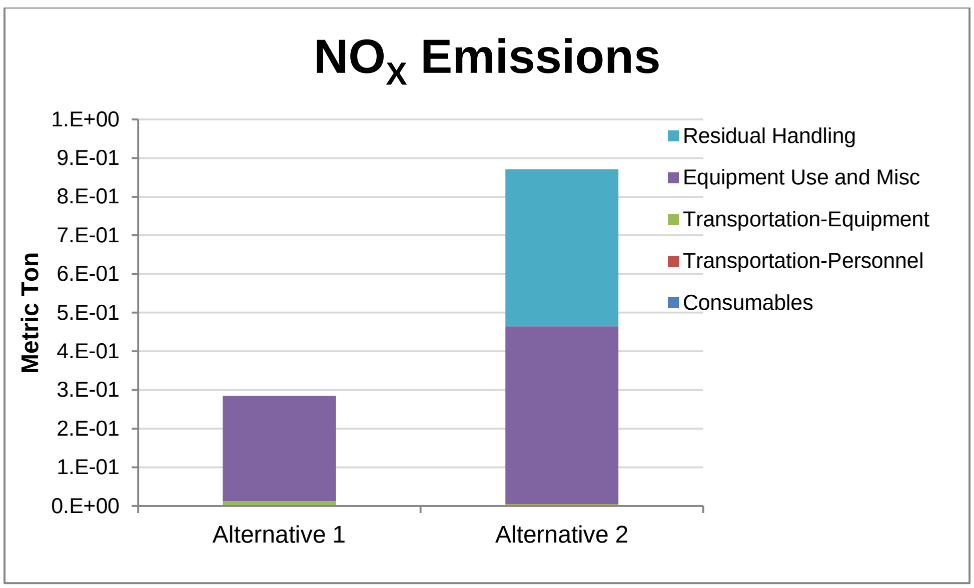


Figure C3: NO_X Emissions for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Figure C4 shows the percentage contribution from each of the main activity sectors.

The total amount of NO_X emissions resulting from the activities that take place during Alternative 1 is 2.85×10^{-1} metric ton. The activity sector with the highest contribution to NO_X emissions is the equipment use and miscellaneous. Equipment use and miscellaneous contributes with 2.7×10^{-1} metric ton of NO_X, which corresponds to 95.7 percent of the total NO_X emissions. Transportation of equipment and material is the activity sector that has the second highest contribution to NO_X emissions. Transportation of equipment and material emits 9.91×10^{-3} metric ton of NO_X, which corresponds to approximately 3.5 percent of the total NO_X emissions resulting from Alternative S-3A. The activity sector with the third highest contribution to NO_X emissions is the transportation of personnel. Transportation of personnel contributes with approximately less than one percent of the total NO_X emissions, corresponding to 2.25×10^{-3} metric ton of NO_X.

The total amount of NO_X emissions for Alternative 2 is 3.26×10^{-1} metric ton. The activity group with the highest contribution to these emissions is the equipment use and miscellaneous sector. The amount of NO_X emissions resulting from the equipment use and miscellaneous sector is 4.6×10^{-1} metric ton, corresponding to approximately 52.8 percent of the total NO_X emissions resulting from Alternative 2. The activity sector with the second highest contribution to NO_X emissions is the residual handling operations. Residual handling operations contributes with 4.06×10^{-1} metric ton of NO_X, corresponding to approximately 46.6 percent of the total NO_X emissions resulting from Alternative 2. The activity sector with the third highest contribution to NO_X emissions is the transportation of personnel. Transportation of personnel releases 2.74×10^{-3} metric ton of NO_X, corresponding to less than one percent of the total NO_X emissions released as a result of Alternative 2.

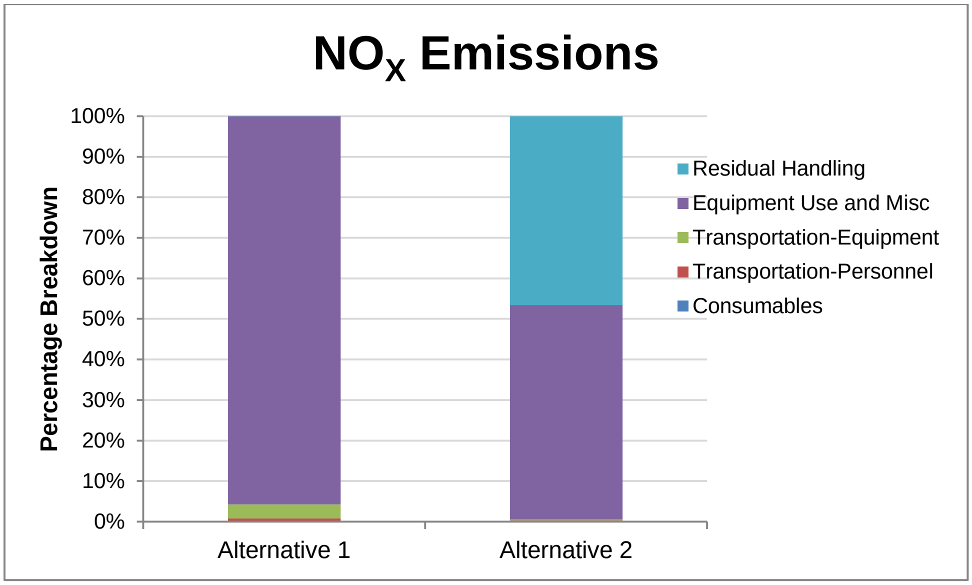


Figure C4: NO_X Emissions percentage breakdown for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

SO_X

Figure C5 contains the distribution of the SO_X emissions resulting from the activities related to Alternatives 1 and 2. The x-axis of this graph represents the alternatives evaluated; the y-axis represents the SO_X emissions in metric tons.

Alternative 1 releases a total of 2.64×10^{-1} metric ton of SO_X. The main contributor to the SO_X emissions is the production of 150,000 sf of HDPE geotextile. The amount of SO_X emissions resulting from this activity is 1.83×10^{-1} metric ton, which corresponds to approximately 69.2 percent of the total SO_X emissions for this Alternative. The use of the 200 hp dozer, which is in operation for 192 hours, is the activity with the second highest contribution to SO_X emissions. The use of the 200 hp dozer releases to the atmosphere 3.8×10^{-2} metric ton of SO_X, corresponding to approximately 14.4 percent of the total SO_X emissions for Alternative 1. The activity with the third highest contribution to NO_X emissions is the use laboratory analytical services. Laboratory analytical services releases 3.27×10^{-2} metric ton of NO_X, which corresponds to 12.4 percent of the total SO_X emissions for Alternative 1.

The total amount of SO_X emissions from Alternative 2 is 3.26×10^{-1} metric ton. The main contributor the SO_X emissions is the residual handling operations, where 6150 ton of materials are transported and disposed of. This specific activity contributes 2.09×10^{-1} metric ton of SO_X, corresponding to approximately 64.3 percent of the total SO_X emissions. The use of the 1200 HP dozer, which is in operation for 224 hours, is the activity with the second highest contribution. The amount of SO_X emissions resulting from the use of the 200 HP dozer is 4.44×10^{-2} metric ton, corresponding to approximately 13.6 percent of the total SO_X emissions for this Alternative. The activity with the third highest contribution to SO_X emissions is the use of laboratory analytical services. Laboratory analytical services releases 3.27×10^{-2} metric ton of SO_X which corresponds to approximately ten percent of the total NO_X emissions for Alternative 2.

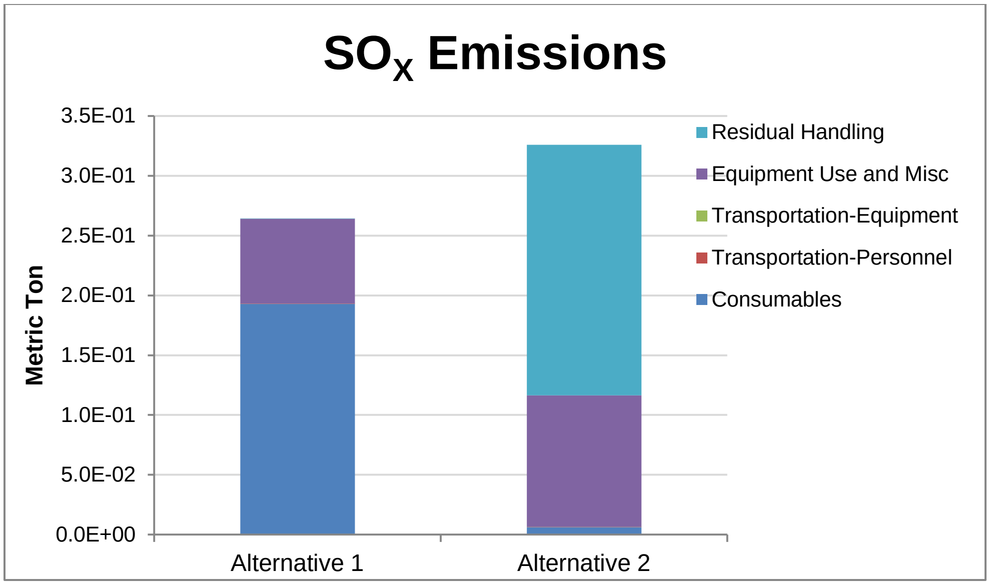


Figure C5: SO_X Emissions for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Figure C6 shows the percentage breakdown of the activities contributing to SO_X emissions.

The total amount of SO_X emissions resulting from the activities that take place during Alternative 1 is 2.64x10-1 metric ton. The activity sector with the highest contribution to SO_X emissions is the production of materials. Production of materials contributes with 1.93×10^{-1} metric ton of SO_X, which corresponds to 73.1 percent of the total SO_X emissions. Equipment use and miscellaneous is the activity sector that has the second highest contribution to SO_X emissions. Equipment use and miscellaneous emits 7.08×10^{-2} metric ton of SO_X, which corresponds to approximately 26.8 percent of the total SO_X emissions resulting from Alternative 1. The activity sector with the third highest contribution to SO_X emissions is the transportation of equipment and materials. Transportation of equipment and materials contributes with approximately less than one percent of the total SO_X emissions, corresponding to 1.75×10^{-4} metric ton of SO_X.

The total amount of SO_X emissions for Alternative 2 is 3.26×10^{-1} metric ton. The activity group with the highest contribution to these emissions is the residual handling operations. The amount of SO_X emissions resulting from the residual handling operations sector is 2.09×10^{-1} metric ton, corresponding to approximately 64.3 percent of the total SO_X emissions resulting from Alternative 2. The activity sector with the second highest contribution to SO_X emissions is the equipment use and miscellaneous. Equipment use and miscellaneous contributes with 1.1×10^{-1} metric ton of SO_X, corresponding to approximately 33.7 percent of the total SO_X emissions resulting from Alternative 2. The activity sector with the third highest contribution to SO_X emissions is the production of materials. Production of materials releases $6.33x10^{-3}$ metric ton of SO_X, corresponding to approximately two percent of the total SO_X emissions released as a result of Alternative 2.

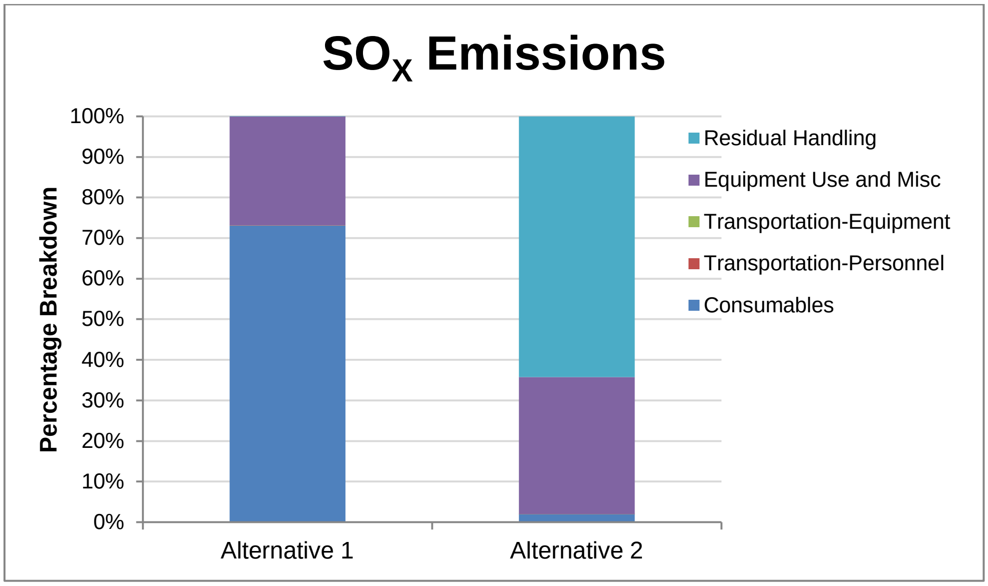


Figure C6: SO_X Emissions percentage breakdown for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

PM_{10}

The breakdown of the distribution of the PM_{10} emissions resulting from the activities involved in Alternatives 1 and 2 are shown in Figure C7. The x-axis of this figure represents the two alternatives evaluated, while the y-axis represents the PM_{10} emissions in metric tons.

Alternative 1 releases a total of $5.07x10^{-2}$ metric ton of PM_{10}. The main contributor to the PM_{10} emissions is the production of 150,000 sf of HDPE geotextile. The amount of PM_{10} emissions resulting from this activity is $2.66x10^{-2}$ metric ton, which corresponds to approximately 52.5 percent of the total PM_{10} emissions for this Alternative. The use of the 200 hp dozer, which is in operation for 192 hours, is the activity with the second highest contribution to PM_{10} emissions. The use of the 200 hp dozer releases to the atmosphere $1.28x10^{-2}$ metric ton of PM_{10}, corresponding to approximately 25.3 percent of the total PM_{10} emissions for Alternative 1. The activity with the third highest contribution to PM_{10} emissions is the use of the 240 hp compactor. The use of the compactor releases $4.34x10^{-3}$ metric ton of PM_{10}, which corresponds to 8.6 percent of the total PM_{10} emissions for Alternative 1.

The total amount of PM_{10} emissions from Alternative 2 is 1.16 metric ton. The main contributor the PM_{10} emissions is the residual handling operations, where 6150 ton of materials are transported and disposed of. This specific activity contributes 1.12 metric ton of PM_{10}, corresponding to approximately 96.5 percent of the total PM_{10} emissions. The use of the 200 HP dozer, which is in operation for 224 hours, is the activity with the second highest contribution. The amount of PM_{10} emissions resulting from the use of the 200 HP dozer is $1.5x10^{-2}$ metric ton, corresponding to approximately 1.3 percent of the total PM_{10} emissions for this Alternative. The activity with the third highest contribution to PM_{10} emissions is the use of the 2.5 CY excavator, which is in operation for 128 hours. The use of the 2.5 CY excavator releases $7.24x10^{-3}$ metric ton of PM_{10} which corresponds to approximately less than one percent of the total PM_{10} emissions for Alternative 2.

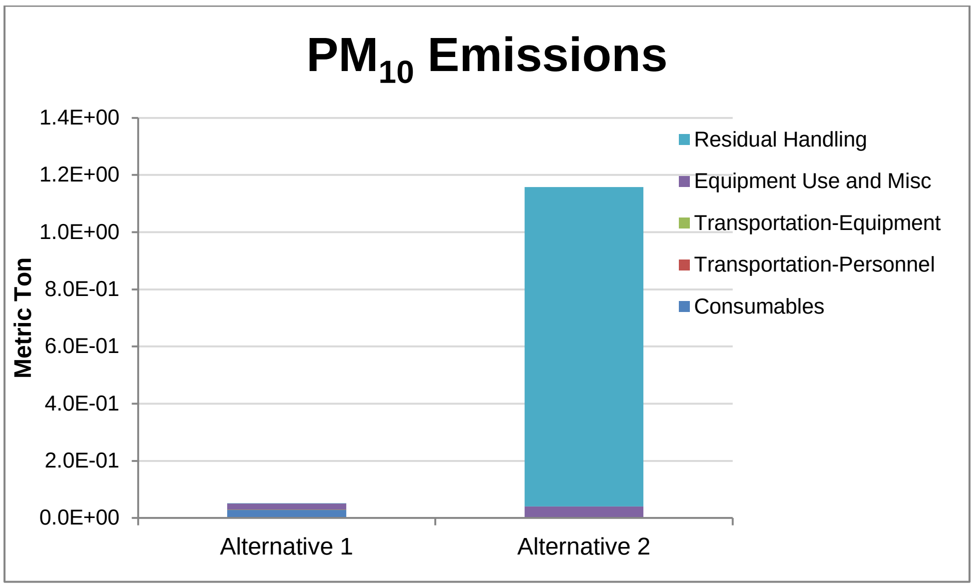


Figure C7: PM_{10} Emissions for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Figure C8 shows the percentage of PM_{10} emissions contributed by each of the activity sectors per alternative.

The total amount of PM_{10} emissions resulting from the activities that take place during Alternative 1 is 5.07x10-2 metric ton. The activity sector with the highest contribution to PM_{10} emissions is the production of materials. Production of materials contributes with $2.79x10^{-2}$ metric ton of PM_{10}, which corresponds to 55 percent of the total PM_{10} emissions. Equipment use and miscellaneous is the activity sector that has the second highest contribution to PM_{10} emissions. Equipment use and miscellaneous emits $2.15x10^{-2}$ metric ton of PM_{10}, which corresponds to approximately 42.3 percent of the total PM_{10} emissions resulting from Alternative 1. The activity sector with the third highest contribution to PM_{10} emissions is the transportation of equipment and materials. Transportation of equipment and materials contributes with approximately 1.7 percent of the total PM_{10} emissions, corresponding to $8.81x10^{-4}$ metric ton of PM_{10}.

The total amount of PM_{10} emissions for Alternative 2 is 1.16 metric ton. The activity group with the highest contribution to these emissions is the residual handling operations. The amount of PM_{10} emissions resulting from the residual handling operations sector is 1.12 metric ton, corresponding to approximately 96.5 percent of the total PM_{10} emissions resulting from Alternative 2. The activity sector with the second highest contribution to PM_{10} emissions is the equipment use and miscellaneous. Equipment use and miscellaneous contributes with 3.93×10^{-2} metric ton of PM_{10}, corresponding to approximately 3.4 percent of the total PM_{10} emissions resulting from Alternative 2. The activity sector with the third highest contribution to PM_{10} emissions is the production of materials. Production of materials releases 6.93×10^{-4} metric ton of PM_{10}, corresponding to less than one percent of the total PM_{10} emissions released as a result of Alternative 2.

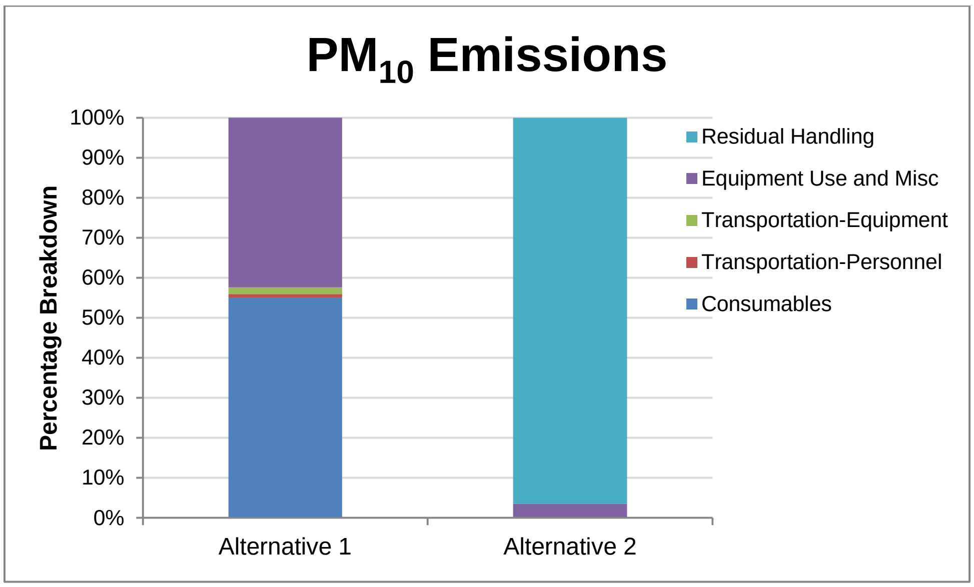


Figure C8: PM_{10} Emissions percentage breakdown for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

<u>Energy Consumption</u>

The energy consumption for each of the alternatives evaluated is shown in Figure C9. The x-axis shows the two alternatives evaluated, and the y-axis shows the amount of energy consumed in units of million British Thermal Units (MMBTU).

The total amount of energy consumed from the activities that take place during Alternative 1 is 14,667.89 MMBTU. The activity with the highest consumption of energy is the production of 3471 cubic yards (CY) of borrow soil. This specific activity utilizes 8,488.08 MMBTU, corresponding to approximately 57.9 percent of the total energy consumed by this Alternative. Production of 2777 CY of gravel is the activity with the second highest consumption of energy. The amount of energy used resulting from the production of gravel is 2,419.49 MMBTU, corresponding to approximately 16.5 percent of the total amount of energy used this Alternative. The activity with the third highest energy consumption is the production of 150,000 sf of HDPE geotextile. Production of HDPE utilizes 1,637.03 MMBTU, which corresponds to approximately 11.2 percent of the total energy consumed by Alternative 1.

Alternative 2 uses a total of 5,911.30 MMBTU during its lifetime. The activity with the highest energy consumption is production of 810 CY of borrow soil. The production of borrow soil utilizes 2,285.43 MMBTY, corresponding to 38.7 percent of the total energy consumption for Alternative 2. The residual handling operations, where 6150 ton of materials are transported and disposed, is the activity with the second highest energy consumption. The amount of energy that is used as a result of this activity is 2,110.55 MMBTU, which corresponds to approximately 35.7 percent of the total energy consumed by this Alternative. The activity with the third highest energy consumption is the use of the 200 hp dozer, which is in use for 224 hours. The use of the dozer consumes 513.72 MMBTU, which corresponds to approximately 8.7 percent of the total energy consumed by Alternative 2.

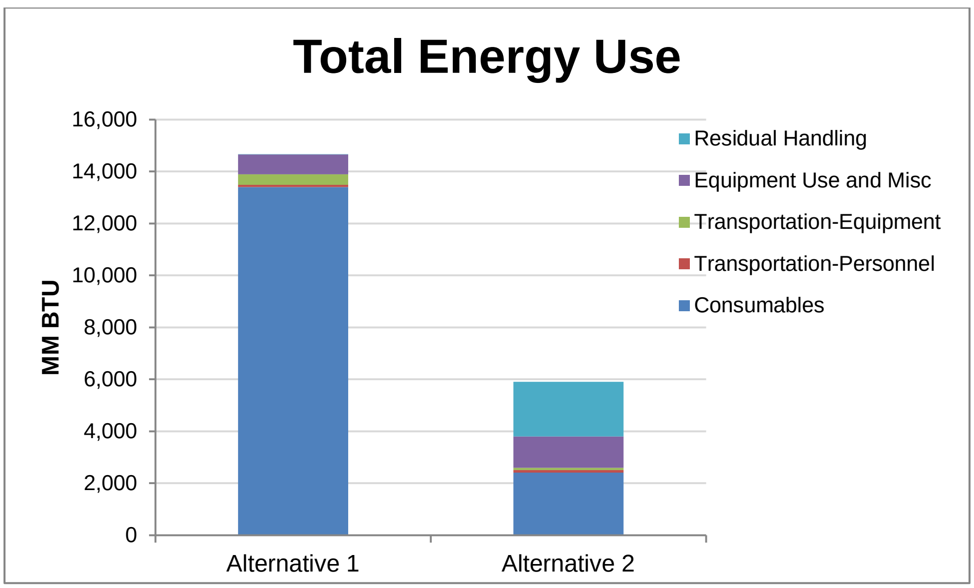


Figure C9: Energy Consumption for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Figure C10 shows the percentage breakdown contribution of energy consumption from the different activity groups.

The total amount of energy consumed by Alternative 1 is 14,667.89 MMBTU. The activity group with the highest energy consumption is the production of materials. The amount energy used resulting from the production of materials sector is 13,405.07 MMBTU, corresponding to approximately 91.4 percent of the total energy consumed by Alternative 1. The activity sector with the second highest energy consumption is the equipment use and miscellaneous. Equipment use and miscellaneous utilizes 768.73 MMBTU, corresponding to approximately 5.2 percent of the total energy consumed by Alternative 1. Transportation of equipment and materials is the activity sector with the third highest energy consumption. Transportation of equipment and materials uses 411.57 MMBTU, which corresponds to approximately 3 percent of the total energy used by the activities of Alternative 1.

The total amount of energy used as a result of the activities that take place during Alternative 2 is 5,911.30 MMBTU. The activity sector with the highest energy consumption is the production of materials. Production of materials uses 2,413.60 MMBTU, which corresponds to 40.8 percent of the total energy consumption. Residual handling operations is the activity sector that has the second highest energy consumption. Residual handling operations consumes 2,110.55 MMBTU, which corresponds to approximately 35.7 percent of the total energy consumption by Alternative 2. The activity sector with the third highest energy consumption is the equipment use and miscellaneous sector. Equipment use and miscellaneous utilizes approximately 20.4 percent of the total energy consumption of Alternative 2, corresponding to 1,203.46 MMBTU.

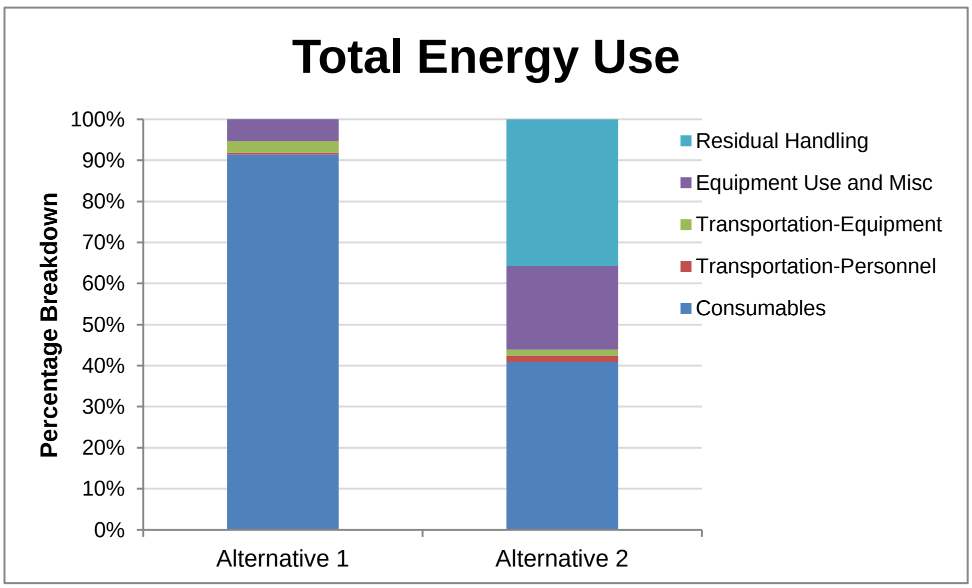


Figure C10: Energy Consumption percentage breakdown for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Water Usage

The water consumption of the evaluated alternatives is shown in Figure C11. The x-axis shows the two evaluated alternatives, and the y-axis show the amount of water consumed in thousands of gallons.

The total water consumption for Alternative 1 is 17.48 thousand gallons of water. The activity with the highest consumption of water is the production of 150,000 sf of HDPE geotextile. The production of HDPE consumes 13.18 thousand gallons of water, corresponding to approximately 75.4 percent of the total water consumed by Alternative 1. The activity with the second highest consumption of water is the production of PVC liners. Production of PVC consumes 2.91 thousand gallons of water, which corresponds to 16.6 percent of the total water consumption of this Alternative. Decontamination water corresponds to 5.7 percent of the total water used during this Alternative; one thousand gallons of water were used for this purpose.

The total water consumption for Alternative 2 is 2.66 thousand gallons of water. Decontamination water has the highest water consumption for this Alternative. The water consumption for decontamination purposes corresponds to 75.1 percent of the total water used during this Alternative; two thousand gallons of water. The activity with the second highest consumption of water is the production of fertilizer for revegetation activities. The production of fertilizer consumes 0.41 thousand gallons of water, corresponding to approximately 15.3 percent of the total water consumed by Alternative 2. The activity with the third highest consumption of water is the production of HDPE. Production of HDPE consumes 0.25 thousand gallons of water, which corresponds to 9.5 percent of the total water consumed by this Alternative.

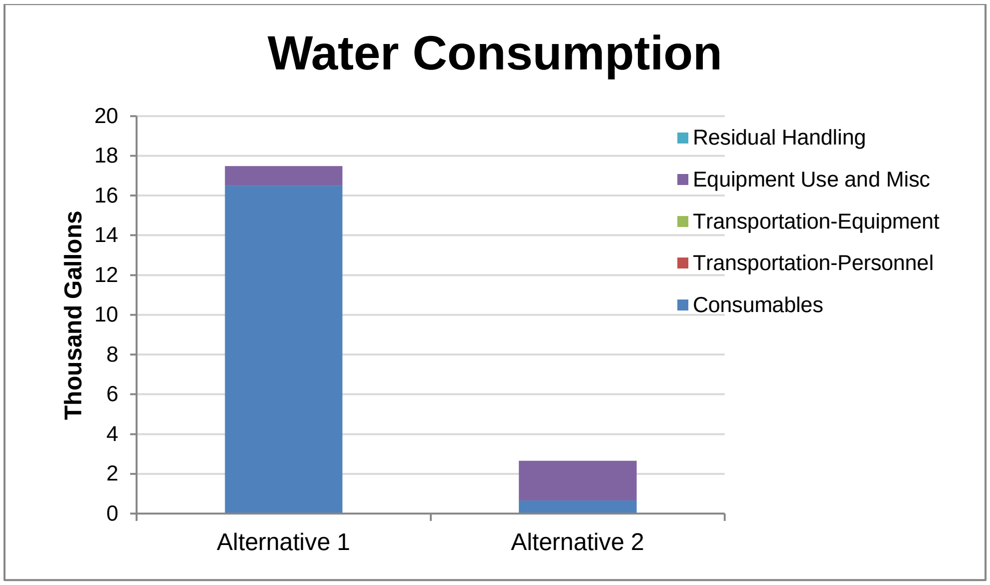


Figure C11: Water Consumption for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Figure C12 has a representation of the percentage breakdown of the contribution of the different sectors of the water use through the lifetime of the alternatives.

The total amount of water consumed during Alternative 1 is 17.48 thousand gallons of water. Production of materials is the activity sector with the highest water consumption. Production of materials consumes 16.48 thousand gallons of water, which corresponds to 94.3 percent of the total water consumption. Equipment use and miscellaneous consumes one thousand gallons of water, which corresponds to 5.7 percent of the total water consumed by Alternative 1.

Alternative 2 consumes 2.66 thousand gallons of water. Equipment use and miscellaneous is the activity sector with the highest water consumption. Equipment use and miscellaneous consumes 2 thousand gallons of water, corresponding to 75.1 percent of the total water used by Alternative 2. Production of materials is the activity sector with the second highest water consumption. Production of materials utilizes 0.66 thousand gallons of water, which corresponds to approximately 25 percent of the total water consumption by Alternative 2.

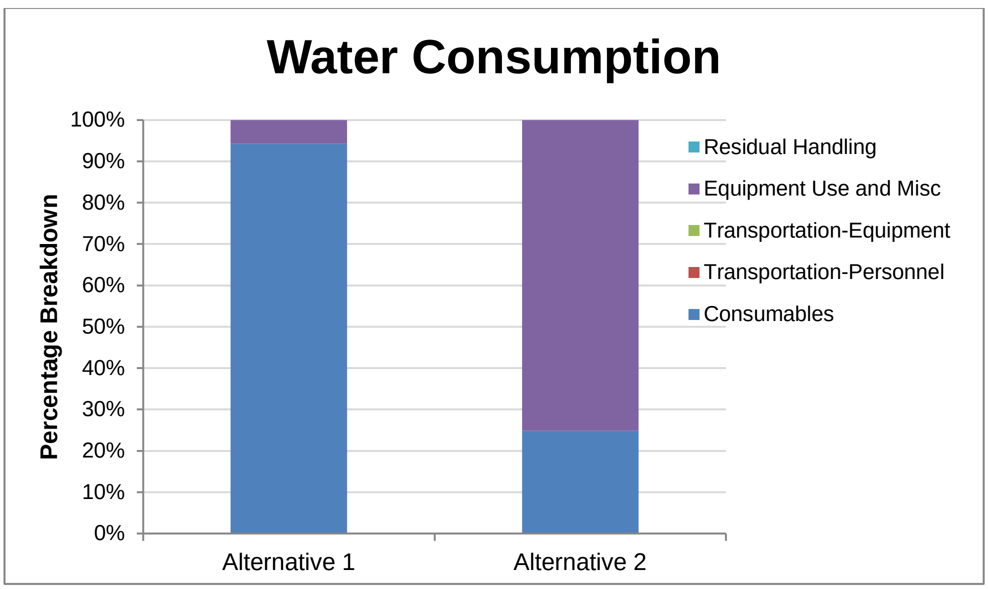


Figure C12: Water Consumption percentage breakdown for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Accident Risk

Accident Risk Fatality

Figure C13 shows the risk of fatality between the evaluated alternatives. The x-axis represents the two alternatives evaluated, and the y-axis represents the risk of fatality.

For both Alternatives, the activity with the highest risk of fatality is the transportation of personnel. For Alternative 1 the activity with the second highest risk of fatality is the transportation of materials and equipment. The activity with the second highest risk of fatality for Alternative 2 is the residual handling operations.

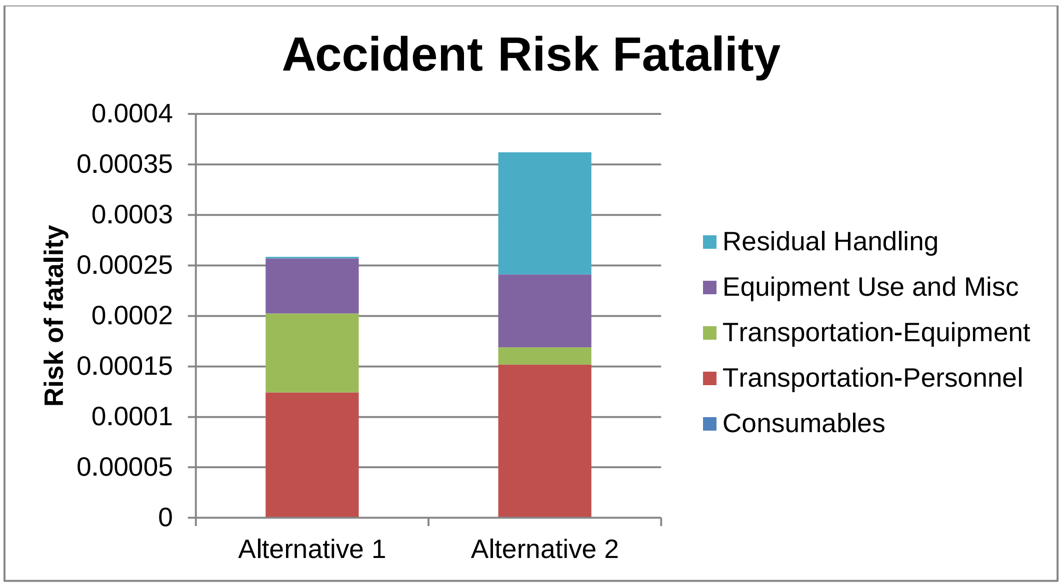


Figure C13: Risk of Fatality for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

Accident Risk Injury

Figure C14 shows the risk of injury between the evaluated alternatives. The x-axis represents the two alternatives evaluated, and the y-axis represents the risk of injury.

For all Alternatives, the activity with the highest risk of injury is the equipment use and miscellaneous, and the activity with the second highest risk of injury is the transportation of personnel.

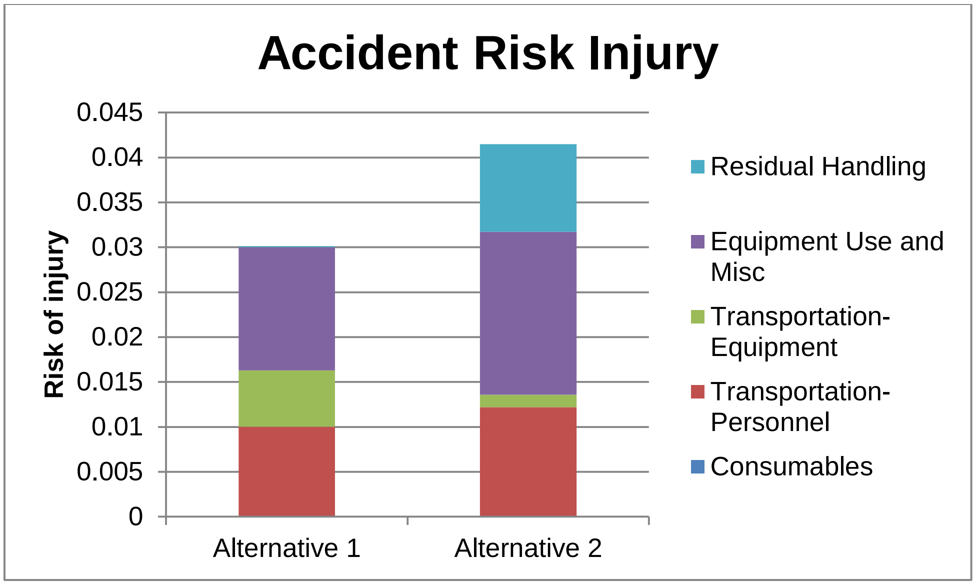


Figure C14: Risk of Injury for Proposed Alternatives at Site 38, Naval Support Facility Indian Head

CONCLUSIONS AND RECOMMENDATIONS

During selection and design of the remedy, a sensitivity analysis considering elements of the remedy that have the greatest impact on remedy effectiveness, life-cycle cost, and environmental footprint metrics may provide additional insight into appropriate optimization. To aid in the sensitivity analysis, an impact analysis summary was created to qualitatively highlight the relative impact of respective metrics for the two alternatives and to identify the primary drivers of emissions, energy consumption, and water usage for each alternative (see Table C2 for details).

Figures C2, C4, C6, C8, C10 and C12 show the percentage breakdown of each of the sectors that take place during the remedial alternatives. In these graphs, it is easy to identify the sector whose contribution is largest from all other sectors to that impact category. An advantage to identifying the large contributors to each of the impact categories evaluated is that the optimization process for lowering the environmental impacts is faster and potentially more efficient.

Measures identified in the evaluation that may reduce the environmental footprint of the alternatives are listed below for consideration.

- All Alternatives: Some reduction of the environmental footprint, particularly GHG emissions and energy consumption, could be realized for all alternatives through the possible use of emission control measures such as alternate fuel sources (e.g. biodiesel), equipment exhaust controls (e.g. diesel), and equipment idle reduction.

- All Alternatives: Consider optimizing of the use of equipment, particularly the use of the dozer, compactor and excavator. Consider the use of alternate pieces of equipment that will be able to perform the work without being a burden to the environmental impact categories.
- All Alternatives: Design an optimized sampling schedule that minimizes the number of samples that need to be analyzed and maximizes the results. Lowering the amount of samples will mean a reduction of environmental impacts.
- All Alternatives: Consider ways to reduce vehicle mileage to reduce worker risk as well as energy use and emissions. Encourage site workers to carpool daily to the site to reduce total vehicle mileage.
- Alternative 1: Consider the revision of volumes of borrow soil needed for the capping activities. Consider the use of a closer source of borrow soil.
- Alternative 1: Consider the revision of the amount of geotextile needed. The use of HDPE Geotextile highly contributes to environmental impacts. Consider the use of a more environmentally friendly material for geotextile or the amount of geotextile used for capping purposes.
- Alternative 2: Consider different modes of transportation for the residual handling operations. An option for residual handling operations is to transport the excavated material by rail to the closest disposal facility.

REFERENCES

(a) NAVFAC, DON Guidance for Optimizing Remedy Evaluation, Selection, and Design, March 2010
(b) NAVFAC, DON Policy on SiteWise™ Optimization/GSR Tool Usage, email received from Brian Harrison/NAVFAC HQ dated 10 AUG 2010

Table C-1
Environmental Footprint Evaluation Results
Site 38, Rum Point Landfill, Naval Support Facility Indian Head
Indian Head, Maryland

Alternative	Activities	GHG Emissions	Total Energy Used	Water Impacts	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		Metric Ton CO_2e	MMBTU	Gallons	Metric Ton	Metric Ton	Metric Ton		
Alternative 1	Materials Production	217.02	13,405.07	16,480.70	4.05E-07	1.93E-01	2.79E-02	NA	NA
	Transportation-Personnel	6.08	76.46	NA	2.25E-03	7.92E-05	4.56E-04	1.24E-04	1.00E-02
	Transportation-Equipment	31.53	411.57	NA	9.91E-03	1.75E-04	8.81E-04	7.81E-05	6.28E-03
	Equipment Use and Misc	48.23	768.73	1,000.00	2.72E-01	7.08E-02	2.15E-02	5.45E-05	1.37E-02
	Residual Handling	0.46	6.06	NA	1.46E-04	2.58E-06	1.30E-05	1.56E-06	1.26E-04
	Total	303.33	14,667.89	17,480.70	2.85E-01	2.64E-01	5.07E-02	0.000	0.030
Alternative 2	Materials Production	28.75	2,413.60	661.37	6.33E-03	6.33E-03	6.93E-04	NA	NA
	Transportation-Personnel	7.41	93.24	NA	9.66E-05	9.66E-05	5.56E-04	1.52E-04	1.22E-02
	Transportation-Equipment	6.93	90.45	NA	3.85E-05	3.85E-05	1.94E-04	1.72E-05	1.38E-03
	Equipment Use and Misc	78.69	1,203.46	2,000.00	1.10E-01	1.10E-01	3.93E-02	7.21E-05	1.81E-02
	Residual Handling	118.54	2,110.55	NA	2.09E-01	2.09E-01	1.12E+00	1.21E-04	9.76E-03
	Total	240.32	5,911.30	2,661.37	3.26E-01	3.26E-01	1.16E+00	0.000	0.041

Table C-2
Environmental Impact Drivers
Site 38, Rum Point Landfill, Naval Support Facility Indian Head
Indian Head, Maryland

Alternatives	GHG Emsissions	Energy Use	Water Consumption	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Risk of injury	Risk of fatality
Alternative 1	High	High	High	Low to moderate	High	Low	Moderate to high	Moderate to high
	Production of borrow soil	Production of borrow soil	Production of HDPE	Use of dozer	Production of HDPE	Production of HDPE	Transportation of personnel	Equipment Use and Miscellaneous
Alternative 2	Moderate to high	Moderate	Low	High	High	High	High	High
	Residual Handling Operations	Production of borrow soil	Decontamination Activities	Residual Handling Operations	Residual Handling Operations	Residual Handling Operations	Transportation of personnel	Equipment Use and Miscellaneous

APPENDIX C-2 INPUT INVENTORIES AND ASSUMPTIONS

Alternative 1: Capping with Land Use Controls

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	441.16	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gallons	
Geotextile, 8oz	2,083.33	lb	37500 sf, 8 oz per sy, Assume HDPE
Gas management Layer, 6in thick	694,000.00	lb	694 CY, Assume 1/3 soil, 1.5 ton/cy, 2000 lb/ton
Gas management Layer, 6in thick	1,186,931.83	lb	694 CY, Assume 2/3 gravel, density 1522 kg/m3,
Geotextile, 12 oz	28,670.81	lb	37500 sf, 12 oz per sy, Assume HDPE
Liner, 40 mil	1,692.71	lb	37500 sf, 6.5 oz per sy, Assume PVC
Geotextile, 12 oz	3,125.00	lb	37500 sf, 12 oz per sy, Assume HDPE
Drainage Layer, 12 in thick	2,671,879.32	lb	2083 CY, Assume 1/2 gravel, density 1522 kg/m3
Drainage Layer, 12 in thick	2,531,438.88	lb	2083 CY, Assume 1/5 sand, density 1442 kg/m3
Geotextile, 8 oz,	2,083.33	lb	37500 sf, 8 oz per sy, Assume HDPE
Common fill	6,249,000.00	lb	2083 CY, Assume soil, 1.5 ton/cy, 2000 lb/ton
Topsoil, 6 in thick	2,082,000.00	lb	694 CY, Assume soil, 1.5 ton/cy, 2000 lb/ton
Seeding, mulch	2,150.00	lb	43 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	860.00	lb	43 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Site Superintendent	2,000.00	miles	40 days, 50 miles per day, 1 person
Site health and Safety & QAQC	4,000.00	miles	40 days, 50 miles per day, 2 people
Site Labor Site Preparation	750.00	miles	5 days, 50 miles per day, 3 people
UXO Technician	250.00	miles	5 days, 50 miles per day, 1 person
UXO Technician	250.00	miles	5 days, 50 miles per day, 1 person
Site Labor Cap	3,750.00	miles	25 days, 50 miles per day, 3 people
Seed Cover Labor	150.00	miles	1 day, 50 miles per day, 3 people

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
Clean Water Storage Tank	0.60	ton	4000 gallons capacity HPDE, 100 miles round trip
Wood chipper (logs) (600 hp)	26.50	ton	1 log chipper, 53,000 lb per woodchipper, 100 miles round trip
Stump Chipper (30 hp)	0.29	ton	1 stup chipper, 579 lb, 100 miles round trip
Dozer, 200 hp	23.85	ton	1 dozer, 47705lb, 100 miles round trip
Smooth Drum Vibratory Roller (125 hp)	11.51	ton	1 vibratory roller, 23016 lb, 100 miles round trip
Dozer, 200 hp	23.85	ton	1 dozer, 47705lb, 100 miles round trip
Smooth Drum Vibratory Roller (125 hp)	11.51	ton	1 vibratory roller, 23016 lb, 100 miles round trip
Sheepsfoot Roller, 240 hp	26.18	ton	1 sheepfoot roller, 25364 lb per unit, 100 miles round trip
Tractor, 220 hp	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
Hydromulcher, 300 gal	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	0.22	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Geotextile, 8oz	1.04	ton	37500 sf, 8 oz per sy, Assume HDPE
Gas management Layer, 6in thick	347.00	ton	694 CY, Assume 1/3 soil, 1.5 ton/cy, 2000 lb/ton
Gas management Layer, 6in thick	593.47	ton	694 CY, Assume 2/3 gravel, density 1522 kg/m3,
Geotextile, 12 oz	14.34	ton	37500 sf, 12 oz per sy, Assume HDPE
Liner, 40 mil	0.85	ton	37500 sf, 6.5 oz per sy, Assume PVC
Geotextile, 12 oz	1.56	ton	37500 sf, 12 oz per sy, Assume HDPE
Drainage Layer, 12 in thick	1,335.94	ton	2083 CY, Assume 1/2 gravel, density 1522 kg/m3
Drainage Layer, 12 in thick	1,265.72	ton	2083 CY, Assume 1/5 sand, density 1442 kg/m3
Geotextile, 8 oz,	1.04	ton	37500 sf, 8 oz per sy, Assume HDPE
Common fill	3,124.50	ton	2083 CY, Assume soil, 1.5 ton/cy, 2000 lb/ton
Topsoil, 6 in thick	1,041.00	ton	694 CY, Assume soil, 1.5 ton/cy, 2000 lb/ton
Seeding, mulch	1.08	ton	43 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.43	ton	43 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
Wood chipper (logs) (600 hp)	19.20	hours	3 days, 8 hours a day, 80% utilization
Stump chipper (30 hp)	19.20	hours	3 days, 8 hours a day, 80% utilization
Dozer, 200 hp	32.00	hours	5 days, 8 hours a day, 80% utilization
Smooth Drum Roller (vibraroty roller 125 hp)	32.00	hours	5 days, 8 hours a day, 80% utilization
Dozer, 200 hp	160.00	hours	25 days, 8 hours a day, 80% utilization
Smooth Drum Roller (vibraroty roller 125 hp)	160.00	hours	25 days, 8 hours a day, 80% utilization
Sheepsfoot Roller, 240 hp	160.00	hours	25 days, 8 hours a day, 80% utilization
Tractor, 220 hp	6.40	hours	1 day, 8 hours a day, 80% utlization
Hydomulcher (15 hp motor, gas)	6.40	hours	1 day, 8 hours a day, 80% utlization

Residual Handling			
Item	Quantity	Units	Comments
Decon Water	4.16	ton	1000 gallons, 8.32 ppg, 2000 lb per ton
Debris Removal and Disposal	40.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon Water	100.00	miles	1000 gallons, 8.32 ppg, 2000 lb per ton
Debris Removal and Disposal	100.00	miles	

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Transportation personnel, site inspection	1,500.00	miles	1 visit per year, 1 day per year, 50 miles per day, 1 person, for years 1 through 30
Transportation personne, monitoring	3,000.00	miles	1 day per visit, 1 visit per year, 50 miles per day, 2 people, for years 1 through 30

5 yr site review	300.00	miles	1 day per visit, 1 visit every 5 years, 50 miles per day, 1 person, years 1 through 30

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Laboratory Analysis	24,000.00	Dollars	4 samples per visit, 1 visit per year, years 1 through 30, $200 per sample

Alternative 2: Landfill Removal with Land Use Controls

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	441.16	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Decon water	2,000.00	gallons	
Topsoil, 6 in thick	2,430,000.00	lb	810 CY, 1.5 ton/CY, 2000 lb per ton
Seeding, mulch	2,250.00	lb	45 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	900.00	lb	45 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Site Superintendent	2,250.00	miles	45 days, 50 miles per day, 1 person
Site health and Safety & QAQC	4,500.00	miles	45 days, 50 miles per day, 2 people
Site Labor Site Preparation	1,500.00	miles	10 days, 50 miles per day, 3 people
UXO Technician	500.00	miles	10 days, 50 miles per day, 1 person
Site Labor excavation and disposal	3,000.00	miles	20 days, 50 miles per day, 3 people
UXO Technician	2,000.00	miles	20 days, 50 miles per day, 2 people
Site Labor for site resotration	750.00	miles	5 days, 50 miles per day, 3 people
Seed Cover Labor	150.00	miles	1 day, 50 miles per day, 3 people

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
Clean Water Storage Tank	0.60	ton	4000 gallons capacity HPDE, 100 miles round trip
Wood chipper (logs) (600 hp)	26.50	ton	1 log chipper, 53,000 lb per woodchipper, 100 miles round trip
Stump Chipper (30 hp)	0.29	ton	1 stup chipper, 579 lb, 100 miles round trip
Dozer, 200 hp	23.85	ton	1 dozer, 47705lb, 100 miles round trip
Excavator, 2.5 CY	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Dump truck	66.00	ton	2 dump trucks, 66000 lb, 100 miles round trip
Loader 5.25 CY (270 hp)	43.61	ton	2 loaders, 43613 lb per loader, 100 miles round trip
Dozer, 200 hp	23.85	ton	1 dozer, 47705lb, 100 miles round trip
Screening Plant, 100 HP	29.00	ton	1 screening plant, 58000lb, 100 miles round trip
Dozer, 200 hp	23.85	ton	1 dozer, 47705lb, 100 miles round trip
Tractor, 220 hp (hydromulching)	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
Hydromulcher, 300 gal (hydromulching)	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip

Transportation-materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	0.22	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Topsoil, 6 in thick	1,215.00	ton	810 CY, 1.5 ton/CY, 2000 lb per ton

Seeding, mulch	1.13	ton	45 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.45	ton	45 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
Wood chipper (logs) (600 hp)	19.20	hours	3 days, 8 hours per day, 80% utilization
Stump Chipper (30 hp)	19.20	hours	3 days, 8 hours per day, 80% utilization
Dozer, 200 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
Excavator 2.5 CY	128.00	hours	20 days, 8 houres per day, 80% utilization
Dump trucks	128.00	hours	2 units, 20 days, 8 hours per day, 80% utilization
Loader 5.25 CY (270 hp)	128.00	hours	2 units, 20 days, 8 hours per day, 80% utilization
Dozer, 200 hp	128.00	hours	20 days, 8 hours per day, 80% utilization
Screening Plant, 100 HP	128.00	hours	20 days, 8 hours per day, 80% utilization
Dozer, 200 hp	32.00	hours	5 days, 8 hours per day, 80% utilization
Tractor, 220 hp (hydromulching)	6.40	hours	1 day, 8 hours per day, 80% utilization
Hydromulcher, 300 gal (hydromulching)	6.40	hours	1 day, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Decon water	8.32	ton	2000 gallons, 8.32 ppg, 2000 lb per ton
Debris removal and disposal	40.00	ton	
Transportation and disposal Subtitle D	6,150.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	2000 gallons, 8.32 ppg, 2000 lb per ton
Debris removal and disposal	100.00	miles	
Transportation and disposal Subtitle D	100.00	miles	

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Transportation personnel, site inspection	1,500.00	miles	1 visit per year, 1 day per year, 50 miles per day, 1 person, for years 1 through 30
Transportation personne, monitoring	3,000.00	miles	1 day per visit, 1 visit per year, 50 miles per day, 2 people, for years 1 through 30
5 yr site review	300.00	miles	1 day per visit, 1 visit every 5 years, 50 miles per day, 1 person, years 1 through 30

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Laboratory Analysis	24,000.00	Dollars	4 samples per visit, 1 visit per year, years 1 through 30, $200 per sample

APPENDIX C-3 SITEWISE™ RESULTS

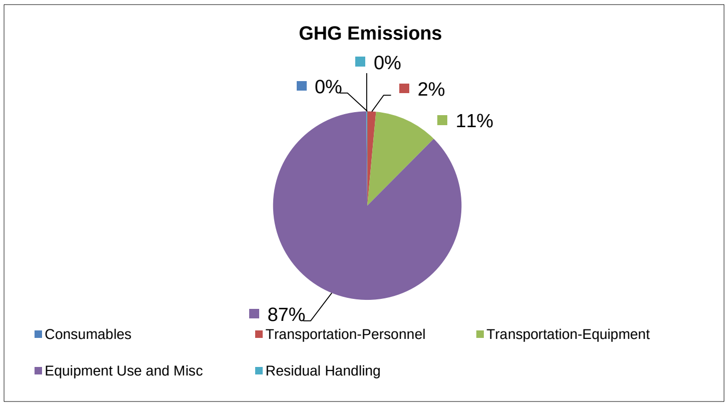
Sustainable Remediation - Environmental Footprint Summary
Alternative 1

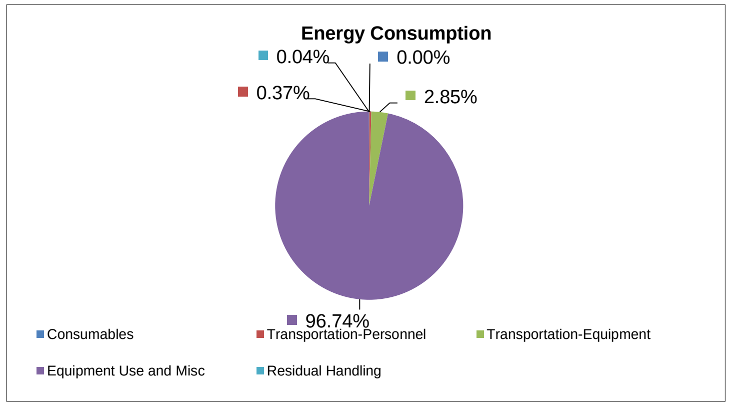
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.25	5.3E+01	NA	1.6E-03	5.5E-05	3.2E-04	8.7E-05	7.0E-03
	Transportation-Equipment	31.53	4.1E+02	NA	9.9E-03	1.8E-04	8.8E-04	7.8E-05	6.3E-03
	Equipment Use and Misc	251.10	1.4E+04	1.7E+04	2.2E-01	2.3E-01	4.8E-02	5.5E-05	1.4E-02
	Residual Handling	0.46	6.1E+00	NA	1.5E-04	2.6E-06	1.3E-05	1.6E-06	1.3E-04
	Sub-Total	287.35	1.44E+04	1.75E+04	2.35E-01	2.31E-01	4.93E-02	2.21E-04	2.71E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.83	2.3E+01	NA	6.8E-04	2.4E-05	1.4E-04	3.7E-05	3.0E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	14.15	2.1E+02	0.0E+00	4.9E-02	3.3E-02	1.2E-03	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	15.98	2.34E+02	0.00E+00	4.97E-02	3.27E-02	1.38E-03	3.74E-05	3.01E-03
Total		**3.0E+02**	**1.5E+04**	**1.7E+04**	**2.8E-01**	**2.6E-01**	**5.1E-02**	**2.6E-04**	**3.0E-02**

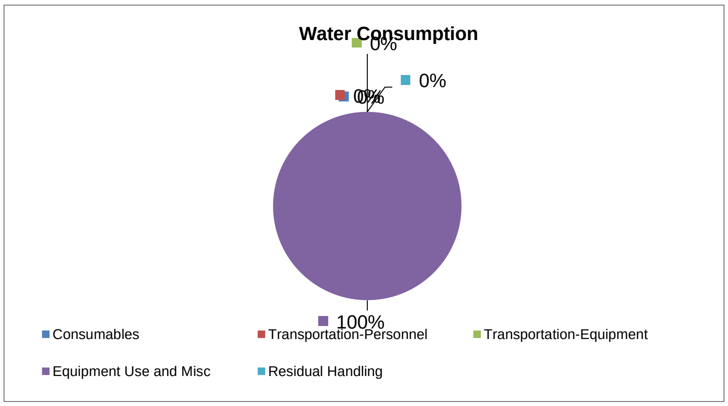
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	3.0E+03	0	2.2E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	2.4E-02
Total	**0.0E+00**	**0.0E+00**	**3.0E+03**	**$0**	**2.4E-01**

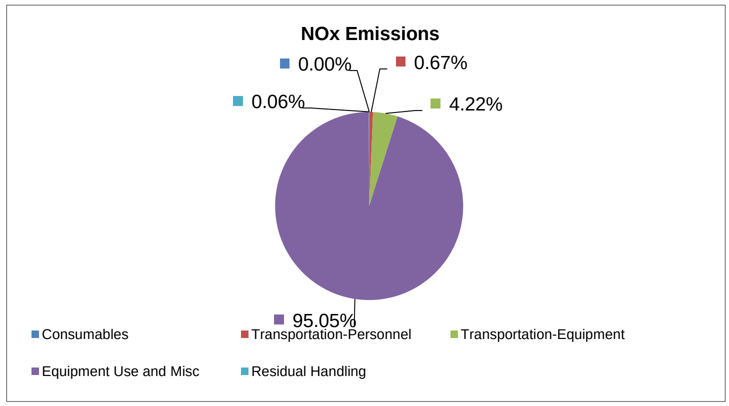
Total Cost with Footprint Reduction
$0

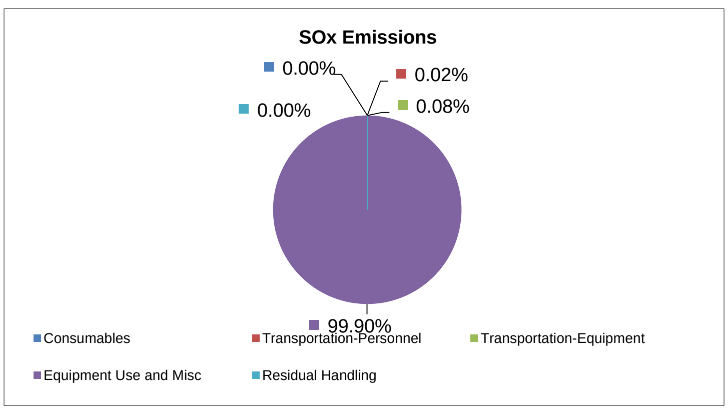
SiteWise™ Results Alternative 1
Remedial Action Construction Stage
Site 38, Rum Point Landfill, Naval Support Facility Indian Head
Indian Head, Maryland

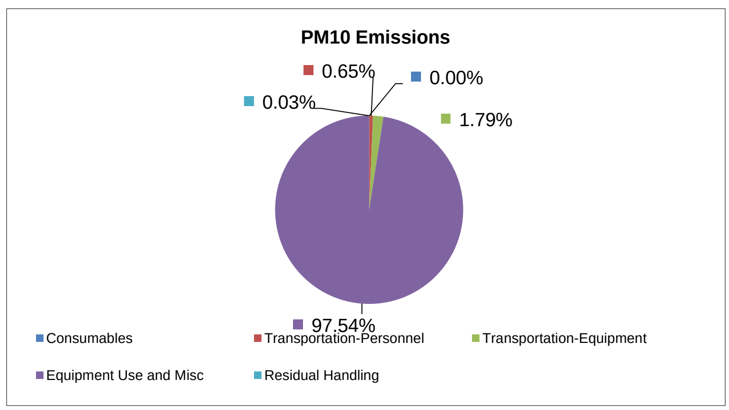


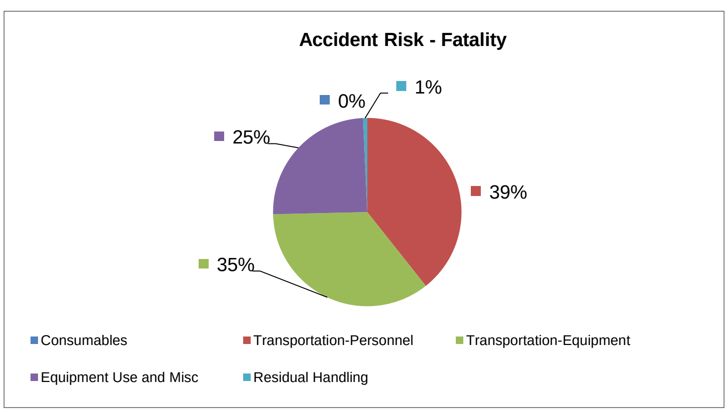


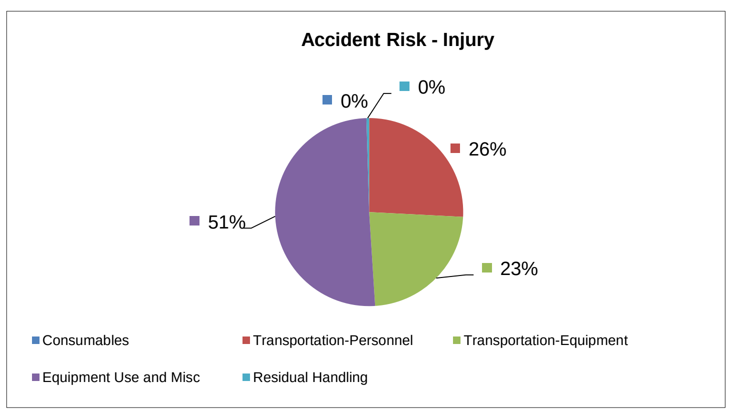


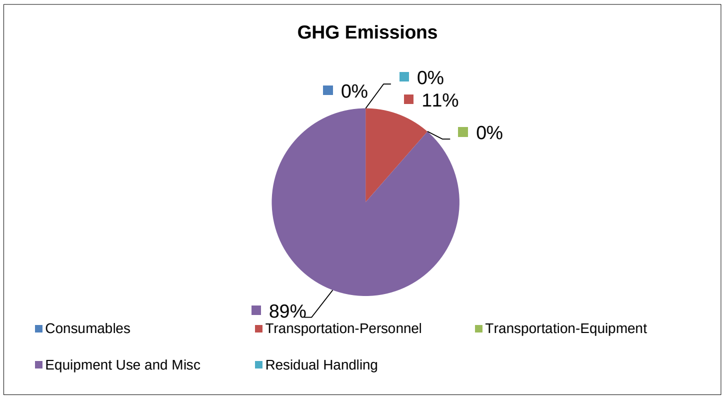


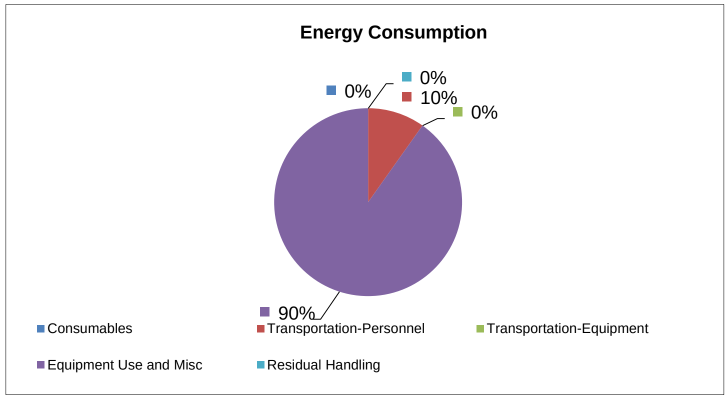


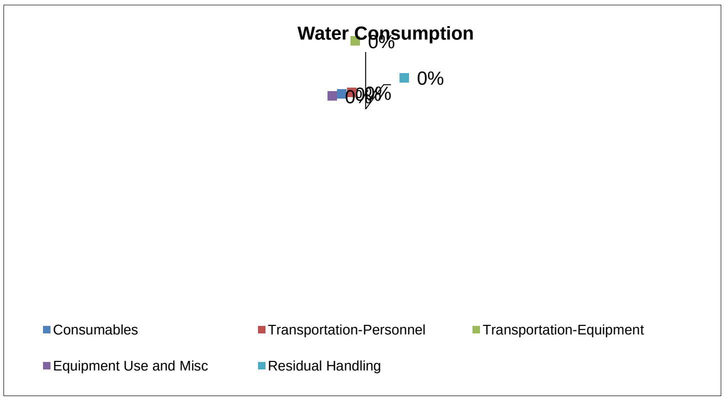


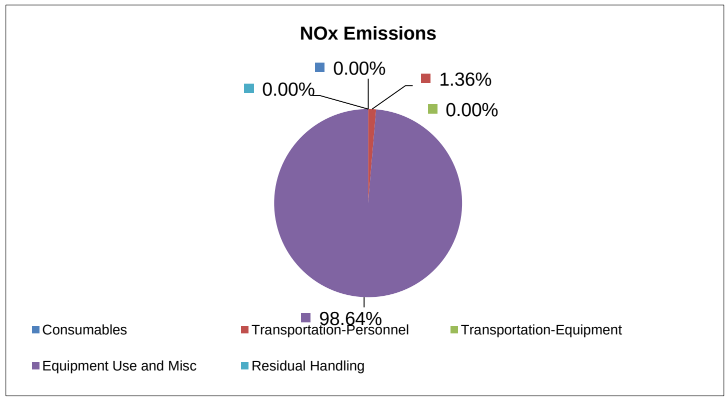


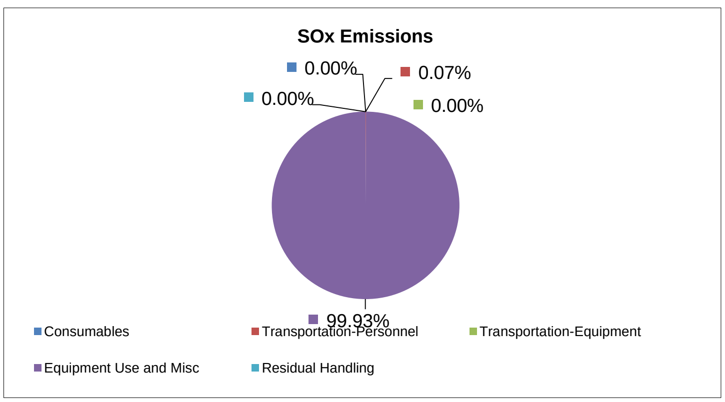


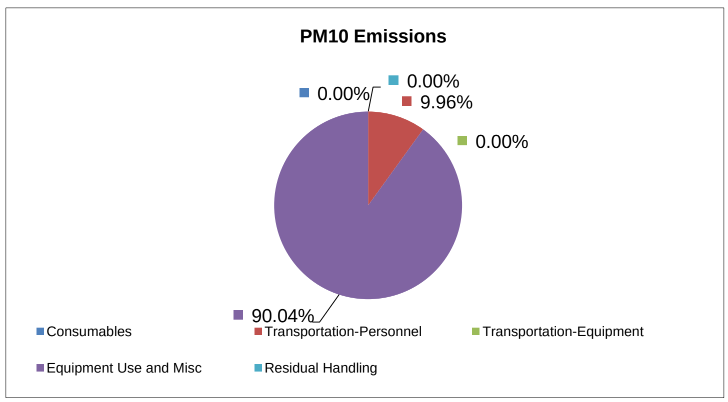

GHG Emissions
0%
0%
11%
0%
89%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

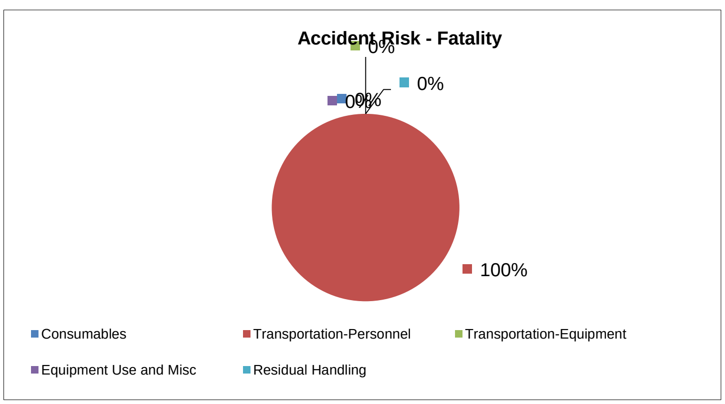

Energy Consumption
0%
0%
10%
0%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

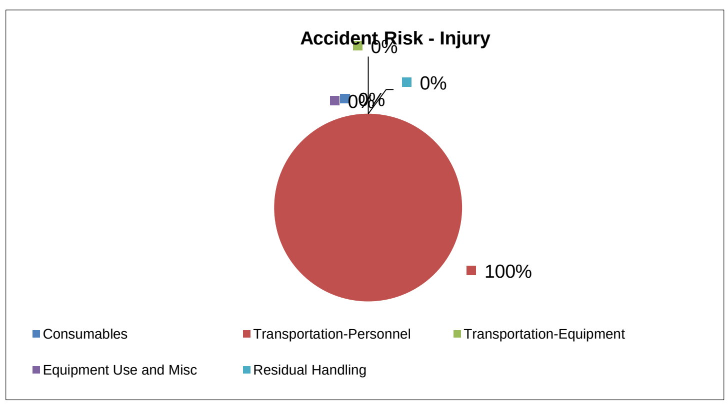

Water Consumption
0%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

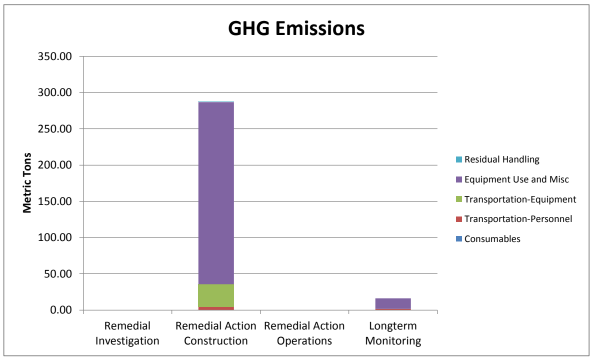

NOx Emissions
0.00%
0.00%
1.36%
0.00%
98.64%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

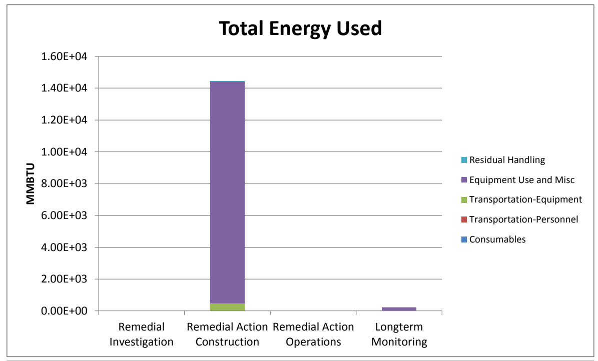

SOx Emissions
0.00%
0.07%
0.00%
0.00%
99.93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

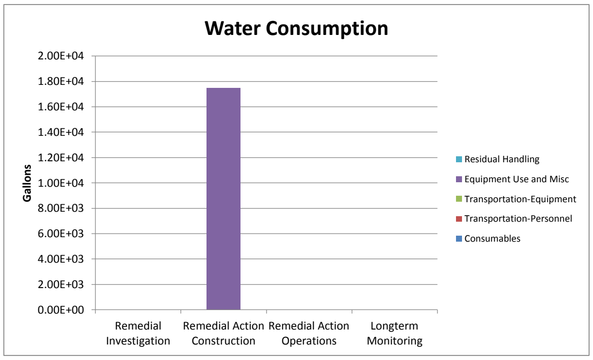

PM10 Emissions
0.00%
0.00%
9.96%
0.00%
90.04%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

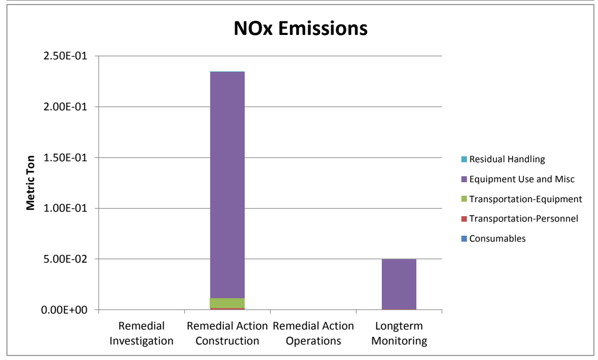

Accident Risk - Fatality
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

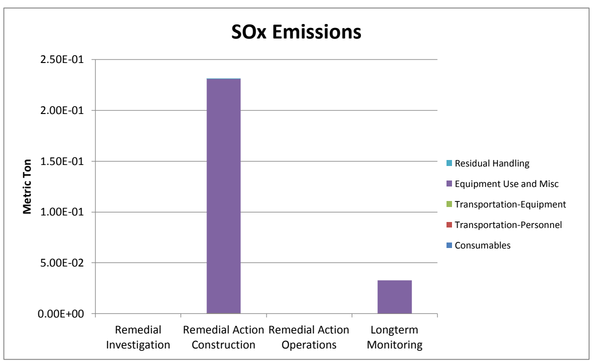

Accident Risk - Injury
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

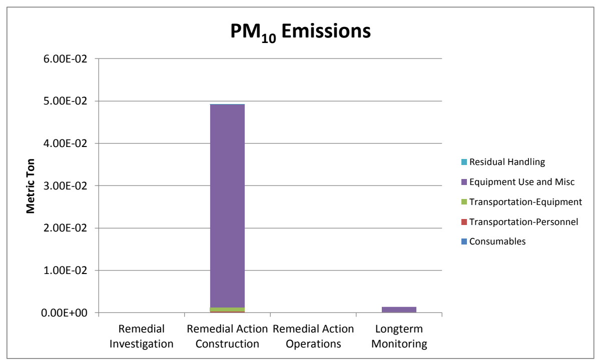

GHG Emissions
Metric Tons
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

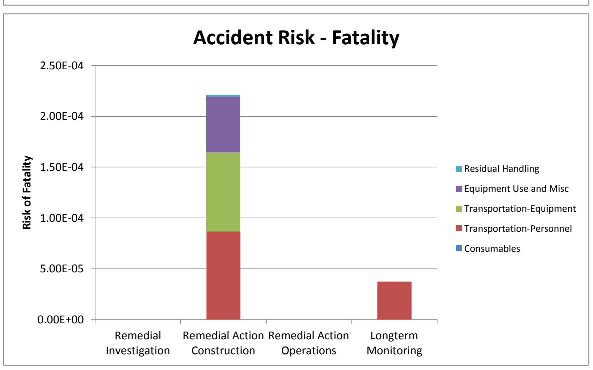

Total Energy Used
MMBTU
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

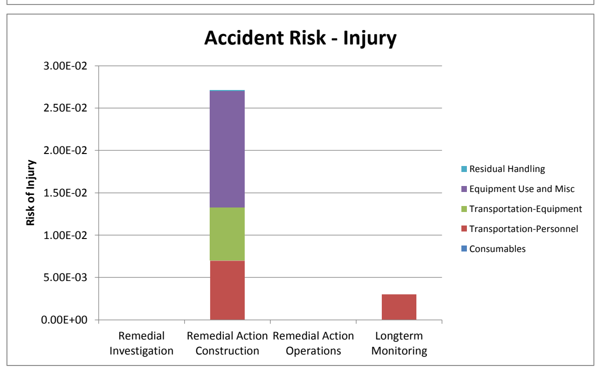

Water Consumption
Gallons
2.00E+04
1.80E+04
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

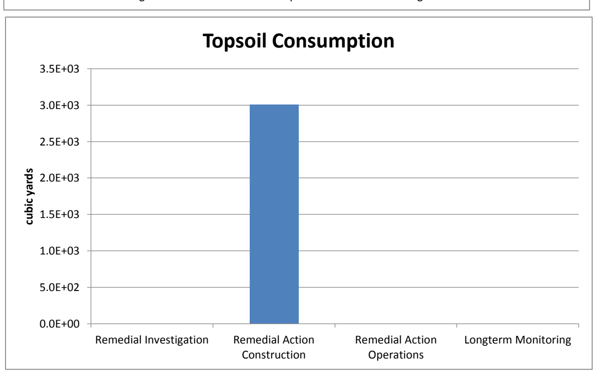

NOx Emissions
Metric Ton
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

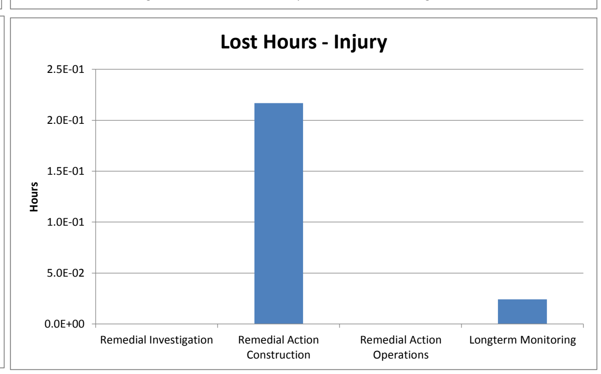

SOx Emissions
Metric Ton
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Topsoil Consumption
cubic yards
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Lost Hours - Injury
Hours
2.5E-01
2.0E-01
1.5E-01
1.0E-01
5.0E-02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3	441.16	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Geotextile, 8oz	HDPE	37500 sf, 8 oz per sy, Assume HDPE	2,083.33	lbs	4.65	2.46	0.01	0.02	0.00	0.01	0.00	27.26	0.75
RAC	Gas management Layer, 6in thick	Soil	694 CY, Assume 1/3 soil, 1.5 ton/cy, 2000 lb/ton	694,000.00	lbs	7.24	7.24	0.00	0.00	0.00	0.00	0.00	191.30	0.00
RAC	Gas management Layer, 6in thick	Gravel	694 CY, Assume 2/3 gravel, density 1522 kg/m3,	1,186,931.83	lbs	9.15	9.15	0.00	0.00	0.00	0.00	0.00	218.12	0.00
RAC	Geotextile, 12 oz	HDPE	37500 sf, 12 oz per sy, Assume HDPE	28,670.81	lbs	63.99	33.81	0.08	0.25	0.00	0.14	0.02	375.20	10.31
RAC	Liner, 40 mil	PVC	37500 sf, 6.5 oz per sy, Assume PVC	1,692.71	lbs	3.81	1.92	0.00	0.02	0.00	0.01	0.00	69.99	2.91
RAC	Geotextile, 12 oz	HDPE	37500 sf, 12 oz per sy, Assume HDPE	3,125.00	lbs	6.97	3.68	0.01	0.03	0.00	0.02	0.00	40.90	1.12
RAC	Drainage Layer, 12 in thick	Gravel	2083 CY, Assume 1/2 gravel, density 1522 kg/m3	2,671,879.32	lbs	20.60	20.60	0.00	0.00	0.00	0.00	0.00	491.00	0.00
RAC	Drainage Layer, 12 in thick	Sand	2083 CY, Assume 1/5 sand, density 1442 kg/m3	2,531,438.88	lbs	5.74	5.74	0.00	0.00	0.00	0.00	0.00	155.06	0.00
RAC	Geotextile, 8 oz,	HDPE	37500 sf, 8 oz per sy, Assume HDPE	2,083.33	lbs	4.65	2.46	0.01	0.02	0.00	0.01	0.00	27.26	0.75
RAC	Common fill	Soil	2083 CY, Assume soil, 1.5 ton/cy, 2000 lb/ton	6,249,000.00	lbs	65.18	65.18	0.00	0.00	0.00	0.00	0.00	1722.52	0.00
RAC	Topsoil, 6 in thick	Soil	694 CY, Assume soil, 1.5 ton/cy, 2000 lb/ton	2,082,000.00	lbs	21.72	21.72	0.00	0.00	0.00	0.00	0.00	573.90	0.00
RAC	Seeding, mulch	Mulch	43 msf, assume mulch assume, 50 lb per msf	2,150.00	lbs	0.68	0.24	0.00	0.00	0.00	0.00	0.00	7.69	0.00
RAC	Seeding, fertilizer	Fertilizer	43 msf, assume fertilizer, assume 20 lb per smf	860.00	lbs	1.07	1.07	0.00	0.00	0.00	0.00	0.00	19.44	0.39
	Subtotal					**217.02**	**176.09**	**0.11**	**0.34**	**0.00**	**0.19**	**0.03**	**3928.80**	**16.48**
Stage	**Construction Equipment**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Wood chipper (logs) (600 hp)	Wood chipper (600 HP)	3 days, 8 hours a day, 80% utilization	19.20	hrs	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.37	
RAC	Stump chipper (30 hp)	Stump chipper (30 hp)	3 days, 8 hours a day, 80% utilization	19.20	hrs	0.18	0.18	0.00	0.00	0.00	0.00	0.00	1.56	
RAC	Dozer, 200 hp	Dozer, 200 HP (D7) w/U Blade (diesel)	5 days, 8 hours a day, 80% utilization	32.00	hrs	3.52	3.52	0.00	0.00	0.02	0.01	0.00	21.51	
RAC	Smooth Drum Roller (vibraroty roller 125 hp)	Roller (125 hp)	5 days, 8 hours a day, 80% utilization	32.00	hrs	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.15	
RAC	Dozer, 200 hp	Dozer, 200 HP (D7) w/U Blade (diesel)	25 days, 8 hours a day, 80% utilization	160.00	hrs	17.58	17.58	0.00	0.00	0.11	0.03	0.01	107.55	
RAC	Smooth Drum Roller (vibraroty roller 125 hp)	Roller (125 hp)	25 days, 8 hours a day, 80% utilization	160.00	hrs	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.77	
RAC	Sheepsfoot Roller, compactor, 240 hp	Compactor 240 hp (diesel)	25 days, 8 hours a day, 80% utilization	160.00	hrs	11.82	11.82	0.00	0.00	0.09	0.00	0.00	29.56	
RAC	Tractor, 220 hp	Tractor, 250 hp, diesel	1 day, 8 hours a day, 80% utlization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	Hydomulcher (15 hp motor, gas)	Hydromulcher 15 hp (gasoline)	1 day, 8 hours a day, 80% utlization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
	Subtotal					**34.08**	**34.08**	**0.00**	**0.00**	**0.22**	**0.04**	**0.02**	**163.40**	**0**
				Total		**251**	**210**	**0.11**	**0.34**	**0.22**	**0.23**	**0.05**	**4,092**	**16**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	251.10	210.18	33.81	7.12	0.22	0.23	0.05	13,962.60	16,480.70
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

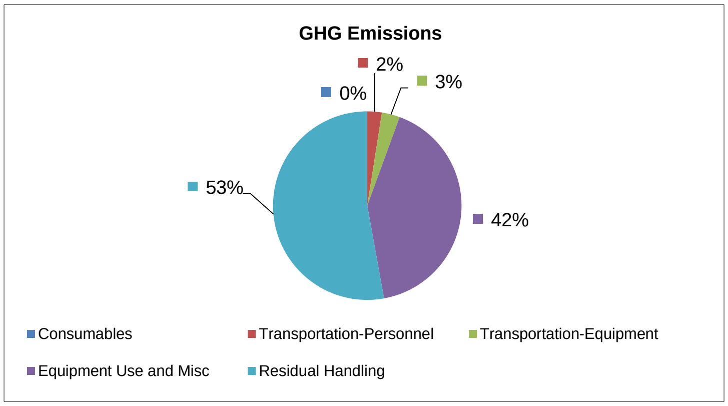
Sustainable Remediation - Environmental Footprint Summary
Alternative 2

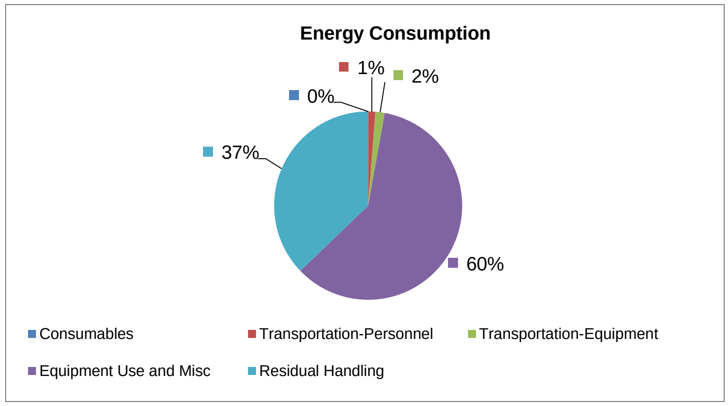
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	5.58	7.0E+01	NA	2.1E-03	7.3E-05	4.2E-04	1.1E-04	9.2E-03
	Transportation-Equipment	6.93	9.0E+01	NA	2.2E-03	3.9E-05	1.9E-04	1.7E-05	1.4E-03
	Equipment Use and Misc	93.28	3.4E+03	2.7E+03	4.1E-01	8.4E-02	3.9E-02	7.2E-05	1.8E-02
	Residual Handling	118.54	2.1E+03	NA	4.1E-01	2.1E-01	1.1E+00	1.2E-04	9.8E-03
	Sub-Total	224.34	5.68E+03	2.66E+03	8.21E-01	2.93E-01	1.16E+00	3.25E-04	3.85E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.83	2.3E+01	NA	6.8E-04	2.4E-05	1.4E-04	3.7E-05	3.0E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	14.15	2.1E+02	0.0E+00	4.9E-02	3.3E-02	1.2E-03	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	15.98	2.34E+02	0.00E+00	4.97E-02	3.27E-02	1.38E-03	3.74E-05	3.01E-03
Total		**2.4E+02**	**5.9E+03**	**2.7E+03**	**8.7E-01**	**3.3E-01**	**1.2E+00**	**3.6E-04**	**4.1E-02**

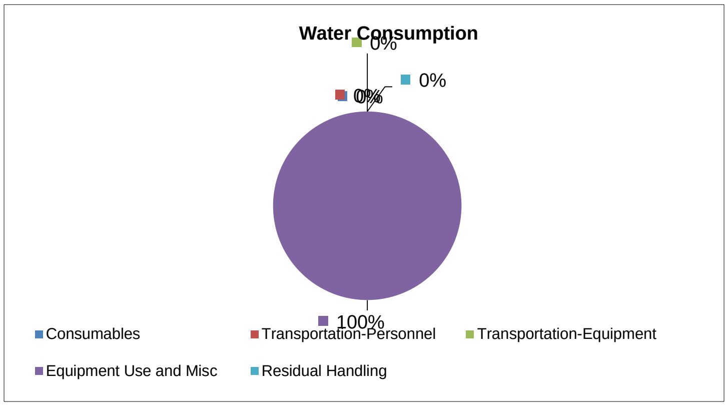
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	6.2E+03	0.0E+00	8.1E+02	0	3.1E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	2.4E-02
Total	**6.2E+03**	**0.0E+00**	**8.1E+02**	**$0**	**3.3E-01**

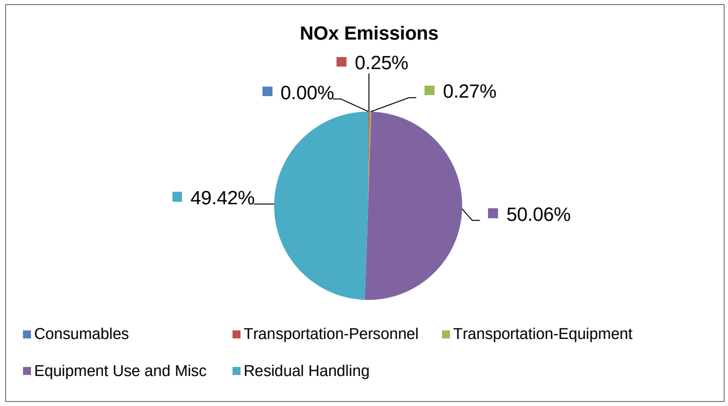
Total Cost with Footprint Reduction
$0

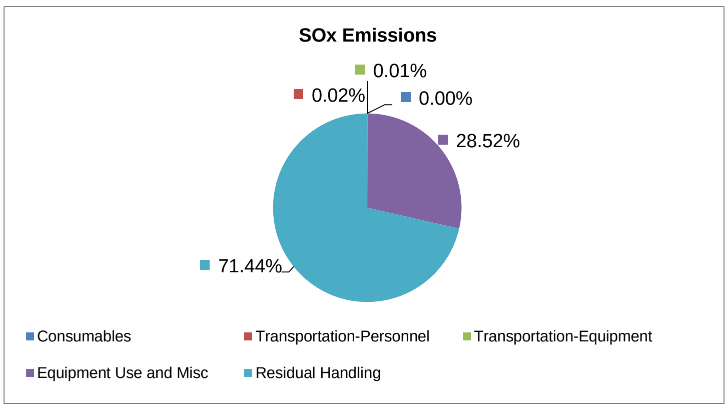
SiteWise™ Results Alternative 2
Remedial Action Construction Stage
Site 38, Rum Point Landfill, Naval Support Facility Indian Head
Indian Head, Maryland

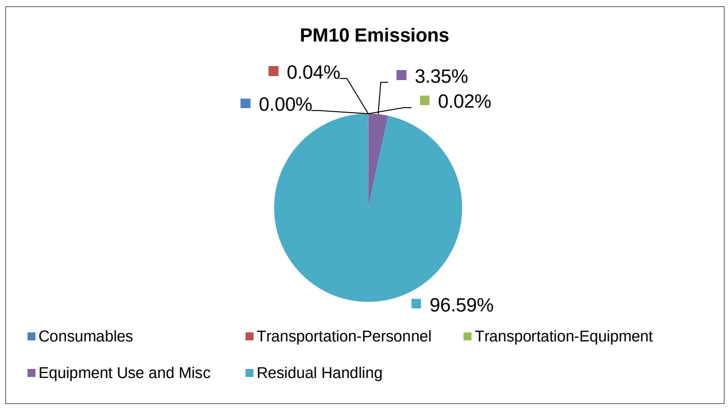


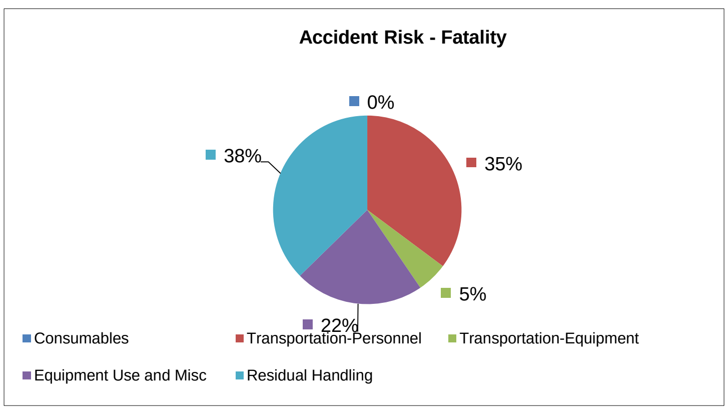


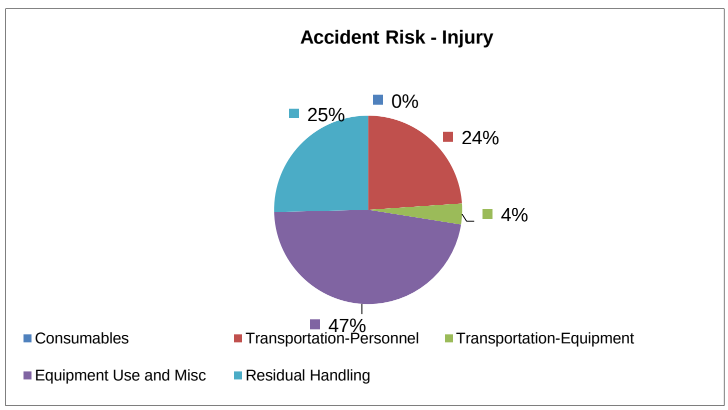




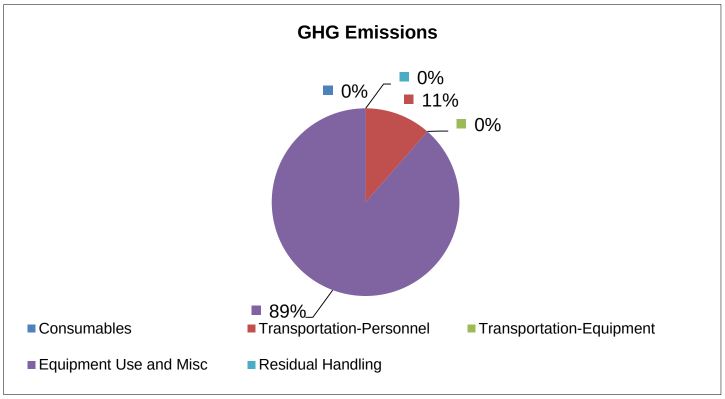


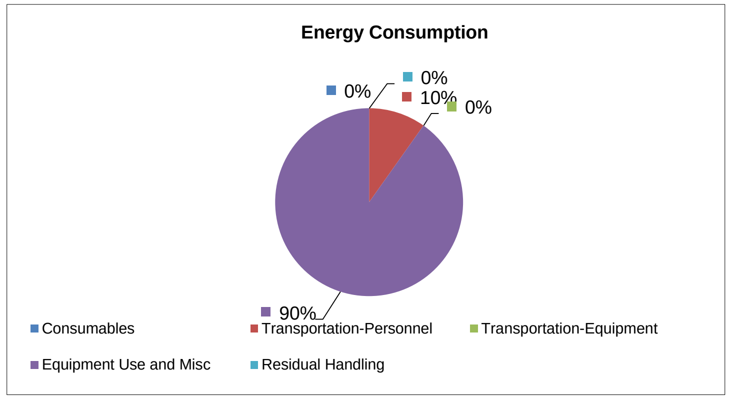


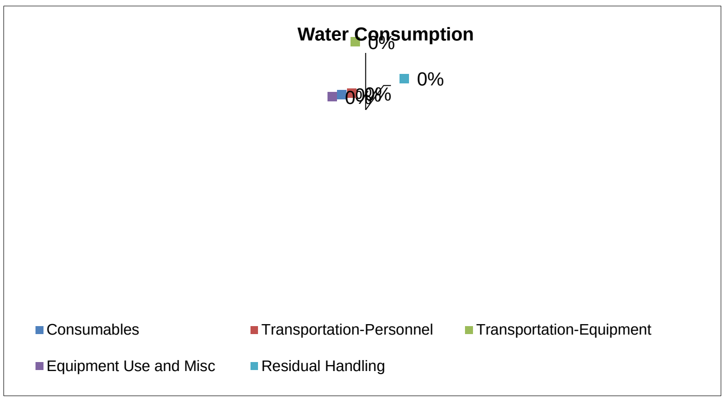


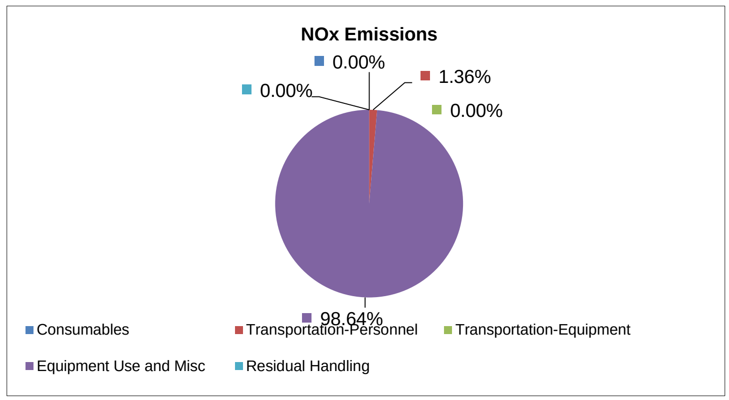


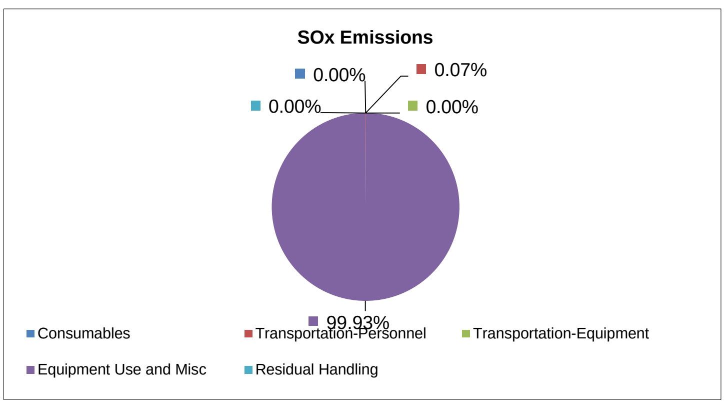
SiteWise™ Results Alternative 2
Long Term Monitoring Stage
Site 38, Rum Point Landfill, Naval Support Facility Indian Head
Indian Head, Maryland

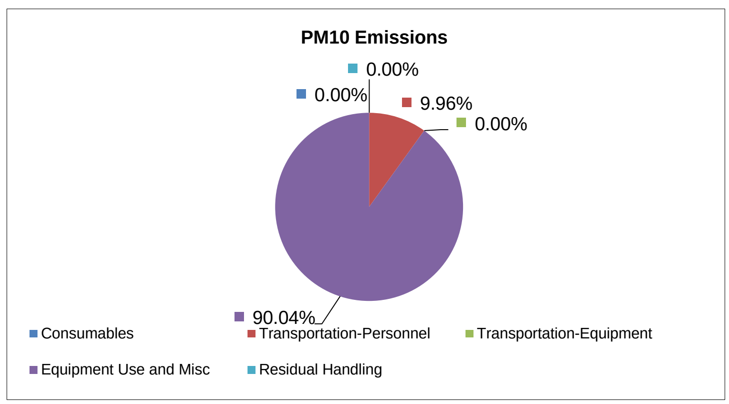


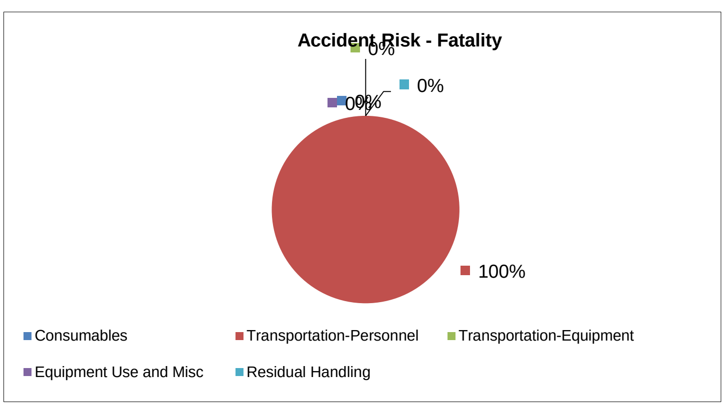


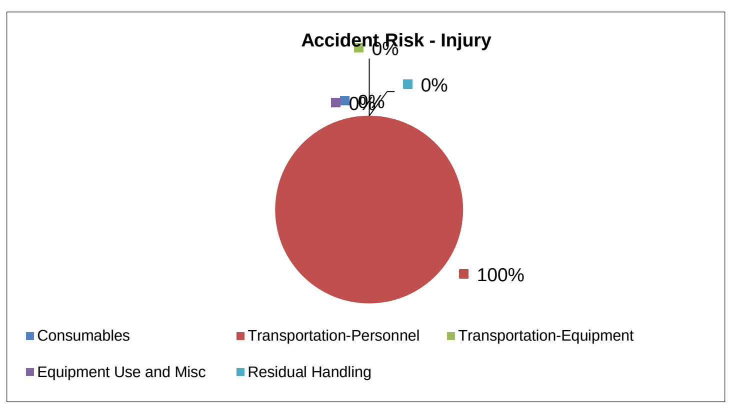


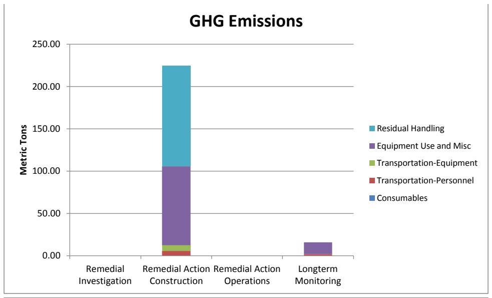


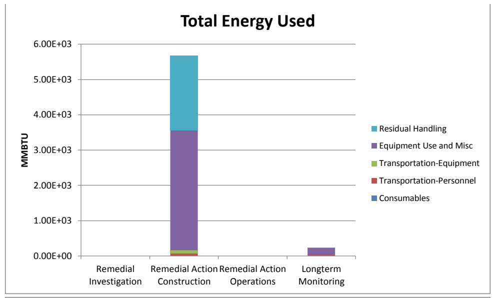


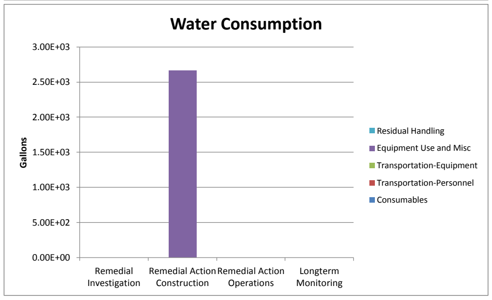


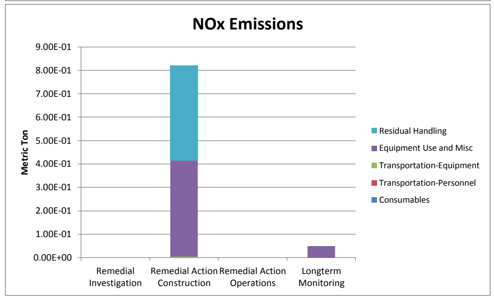


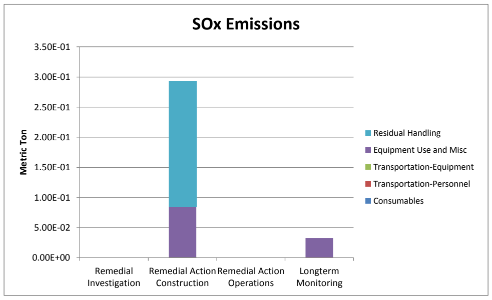


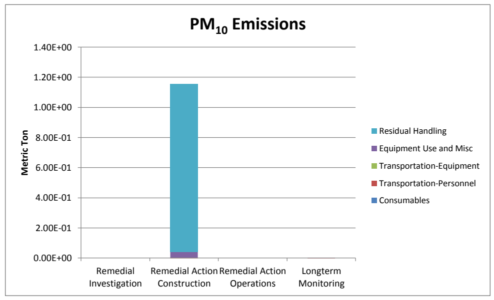

GHG Emissions
Metric Tons
250.00
200.00
150.00
100.00
50.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

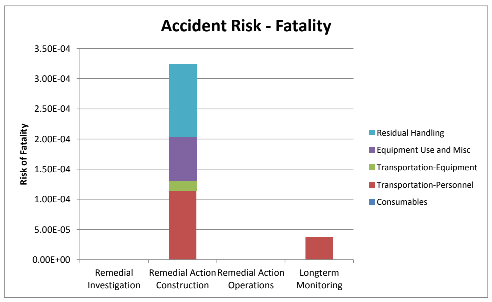

Total Energy Used
MMBTU
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

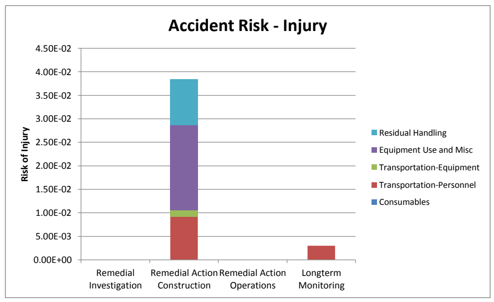

Water Consumption
Gallons
3.00E+03
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

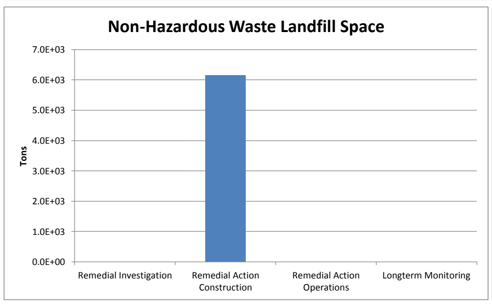

NOx Emissions
Metric Ton
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

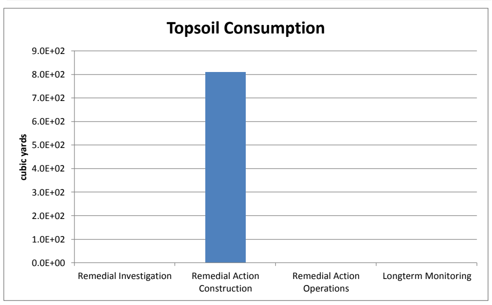

SOx Emissions
Metric Ton
3.50E-01
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

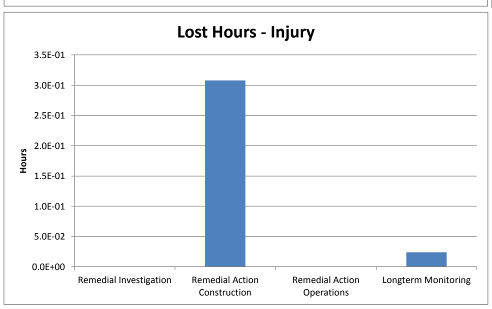

PM_{10} Emissions
Metric Ton
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.50E-04
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
4.50E-02
4.00E-02
3.50E-02
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
7.0E+03
6.0E+03
5.0E+03
4.0E+03
3.0E+03
2.0E+03
1.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
9.0E+02
8.0E+02
7.0E+02
6.0E+02
5.0E+02
4.0E+02
3.0E+02
2.0E+02
1.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Lost Hours - Injury
Hours
3.5E-01
3.0E-01
2.5E-01
2.0E-01
1.5E-01
1.0E-01
5.0E-02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3	441.16	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Topsoil, 6 in thick	Soil	810 CY, 1.5 ton/CY, 2000 lb per ton	2,430,000.00	lbs	25.35	25.35	0.00	0.00	0.00	0.00	0.00	669.82	0.00
RAC	Seeding, mulch	Mulch	45 msf, assume mulch assume, 50 lb per msf	2,250.00	lbs	0.71	0.25	0.00	0.00	0.00	0.00	0.00	8.05	0.00
RAC	Seeding, fertilizer	Fertilizer	45 msf, assume fertilizer, assume 20 lb per smf	900.00	lbs	1.12	1.12	0.00	0.00	0.00	0.00	0.00	20.34	0.41
	Subtotal					**28.75**	**27.55**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**707.39**	**0.66**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Wood chipper (logs) (600 hp)	Wood chipper (600 HP)	3 days, 8 hours per day, 80% utilization	19.20	hrs	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.37	
RAC	Stump Chipper (30 hp)	Stump chipper (30 hp)	3 days, 8 hours per day, 80% utilization	19.20	hrs	0.18	0.18	0.00	0.00	0.00	0.00	0.00	1.56	
RAC	Dozer, 200 hp	Dozer, 200 HP (D7) w/U Blade (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	7.03	7.03	0.00	0.00	0.04	0.01	0.00	43.02	
RAC	Excavator 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	20 days, 8 houres per day, 80% utilization	128.00	hrs	12.41	12.41	0.00	0.00	0.08	0.02	0.01	56.31	
RAC	Dump trucks	Dump Truck (40 0hp, Diesel) off road	2 units, 20 days, 8 hours per day, 80% utilization	128.00	hrs	17.00	17.00	0.00	0.00	0.09	0.00	0.01	31.27	
RAC	Loader 5.25 CY (270 hp)	Loader, 270 HP, 5.25 CY (diesel)	2 units, 20 days, 8 hours per day, 80% utilization	128.00	hrs	4.15	4.15	0.00	0.00	0.04	0.01	0.00	15.12	
RAC	Dozer, 200 hp	Dozer, 200 HP (D7) w/U Blade (diesel)	20 days, 8 hours per day, 80% utilization	128.00	hrs	14.06	14.06	0.00	0.00	0.09	0.03	0.01	86.04	
RAC	Screening Plant, 100 HP	Screening plant (100 hp)	20 days, 8 hours per day, 80% utilization	128.00	hrs	5.57	5.57	0.00	0.00	0.04	0.00	0.00	33.68	
RAC	Dozer, 200 hp	Dozer, 200 HP (D7) w/U Blade (diesel)	5 days, 8 hours per day, 80% utilization	32.00	hrs	3.52	3.52	0.00	0.00	0.02	0.01	0.00	21.51	
RAC	Tractor, 220 hp (hydromulching)	Tractor, 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	Hydromulcher, 300 gal (hydromulching)	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
	Subtotal					**64.54**	**64.54**	**0.00**	**0.00**	**0.41**	**0.08**	**0.04**	**290.82**	**0**
				Total		**93**	**92**	**0.00**	**0.01**	**0.41**	**0.08**	**0.04**	**998**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	93.28	92.09	1.06	0.14	0.41	0.08	0.04	3,405.86	661.37
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

APPENDIX D

CONCEPTUAL DESIGN CALCULATIONS AND COST ESTIMATES

NAVAL SUPPORT FACILITY - INDIAN HEAD
Indian Head, Maryland
Site 38 - Rum Point Landfill
Alternative 2: Capping with Land Use Controls
Capital Cost

7/11/2012 3:21 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare LUC Documents	150	hr			$39.00		$0	$0	$5,850	$0	$5,850
1.2 Prepare Documents & Plans including Permits	300	hr			$39.00		$0	$0	$11,700	$0	$11,700
1.3 Prepare Monitoring Plan	120	hr			$39.00		$0	$0	$4,680	$0	$4,680
1.4 Completion Report	80	hr			$39.00		$0	$0	$3,120	$0	$3,120
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	8	ea			$188.00	$566.00	$0	$0	$1,504	$4,528	$6,032
2.3 Utility Connection/Disconnection (phone/electric)	1	ls	$1,500.00				$1,500	$0	$0	$0	$1,500
3 FIELD SUPPORT											
3.1 Office Trailer	2	mo				$365.00	$0	$0	$0	$730	$730
3.2 Field Office Equipment, Utilities, & Support	2	mo		$508.00			$0	$1,016	$0	$0	$1,016
3.3 Storage Trailer	2	mo				$94.00	$0	$0	$0	$188	$188
3.4 Construction Layout Survey	6	day	$1,150.00				$6,900	$0	$0	$0	$6,900
3.5 Site Superintendent	40	day		$134.00	$480.00		$0	$5,360	$19,200	$0	$24,560
3.6 Site Health & Safety and QA/QC	40	day		$134.00	$360.00		$0	$5,360	$14,400	$0	$19,760
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,250.00	$2,350.00	$1,550.00	$0	$1,250	$2,350	$1,550	$5,150
4.2 Temporary Equipment Decon Pad	1	ls		$1,600.00	$2,200.00	$400.00	$0	$1,600	$2,200	$400	$4,200
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$731.00	$0	$0	$0	$731	$731
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$990.00				$990	$0	$0	$0	$990
5 SITE PREPARATION											
5.1 Underground Utility Clearance	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
5.2 Tree Chipper	3	day				$710.60	$0	$0	$0	$2,132	$2,132
5.3 Stump Chipper	3	day				$170.70	$0	$0	$0	$512	$512
5.4 Dozer, 200 hp	5	day			$372.40	$1,243.00	$0	$0	$1,862	$6,215	$8,077
5.5 Smooth Drum Roller	5	day			$372.40	$640.20	$0	$0	$1,862	$3,201	$5,063
5.6 Site Labor, (3 laborers)	15	day			$280.80		$0	$0	$4,212	$0	$4,212
5.7 UXO Technician	5	day		$134.00	$345.00		$0	$670	$1,725	$0	$2,395
5.8 Debris Removal & Disposal	40	ton	$56.00				$2,240	$0	$0	$0	$2,240
6 CAP											
6.1 Geotextile, 8 oz	37,500	sf		$0.13	$0.02		$0	$4,875	$750	$0	$5,625
6.2 Gas Management Layer, 6" thick	694	cy		$33.02			$0	$22,916	$0	$0	$22,916
6.3 Gas Vents	1	ls		$3,200.00			$0	$3,200	$0	$0	$3,200
6.4 Geotextile, 12 oz.	37,500	sf		$0.19	$0.02		$0	$7,125	$750	$0	$7,875
6.5 Liner, 40 mil	37,500	sf		$0.39	$0.37	$0.07	$0	$14,625	$13,875	$2,625	$31,125
6.6 Geotextile, 12 oz.	37,500	sf		$0.19	$0.02		$0	$7,125	$750	$0	$7,875
6.7 Drainage Layer, 12" thick	2,083	cy		$34.55			$0	$71,968	$0	$0	$71,968
6.8 Geotextile, 8 oz	37,500	sf		$0.13	$0.02		$0	$4,875	$750	$0	$5,625
6.9 Common Fill	2,083	cy		$18.83			$0	$39,223	$0	$0	$39,223
6.10 Topsoil, 6" thick	694	cy		$27.33			$0	$18,967	$0	$0	$18,967
6.11 Seed Cover	43	msf	$96.50				$4,150	$0	$0	$0	$4,150
6.12 UXO Technician	5	day		$134.00	$345.00		$0	$670	$1,725	$0	$2,395
6.13 Dozer, 200 hp	25	day			$372.40	$1,243.00	$0	$0	$9,310	$31,075	$40,385
6.14 Smooth Drum Roller	25	day			$372.40	$640.20	$0	$0	$9,310	$16,005	$25,315
6.15 Sheepsfoot Roller	25	day			$372.40	$1,101.00	$0	$0	$9,310	$27,525	$36,835
6.16 Site Labor, (3 laborers)	75	day			$280.80		$0	$0	$21,060	$0	$21,060
Subtotal							$23,280	$212,024	$142,255	$101,730	$479,289

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
Overhead on Labor Cost @ 30%									$42,677		$42,677
G & A on Sub, Material, Labor, & Equipment Cost @ 10%							$2,328	$21,202	$14,226	$10,173	$47,929
Tax on Materials and Equipment Cost @ 6%								$12,721		$6,104	$18,825
Total Direct Cost							$25,607	$245,948	$199,157	$118,007	$588,719
Indirects on Total Direct Cost @ 20%											$117,744
Profit on Total Direct Cost @ 10%											$58,872
Subtotal											$765,335
Health & Safety Monitoring @ 2%											$15,307
Total Field Cost											$780,642
Contingency on Total Field Costs @ 20%											$156,128
Engineering on Total Field Cost @ 10%											$78,064
TOTAL CAPITAL COST											**$1,014,835**

NAVAL SUPPORT FACILITY - INDIAN HEAD
Indian Head, Maryland
Site 38 - Rum Point Landfill
Alternative 2: Capping with Land Use Controls
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Site Inspection	$6,586		Labor and supplies to visit site once a year to inspect Land Use Controls with Report
Monitoring Sampling	$7,500		Labor and supplies to collect samples from 4 wells, annually years 1-30.
Monitoring Sampling Analysis/Water	$2,296		Analyze groundwater samples for VOCs, SVOCs, and inorganics including QA/QC cost.
Site Review		$23,000	Five-Year Site Reviews
SUBTOTAL	$16,382	$23,000	
Contingency @ 10%	$1,638	$2,300	
TOTAL	**$18,020**	**$25,300**	

NAVAL SUPPORT FACILITY - INDIAN HEAD
Indian Head, Maryland
Site 38 - Rum Point Landfill
Alternative 2: Capping with Land Use Controls
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,014,835		$1,014,835	1.000	$1,014,835
1		$18,020	$18,020	0.980	$17,667
2		$18,020	$18,020	0.961	$17,320
3		$18,020	$18,020	0.942	$16,981
4		$18,020	$18,020	0.924	$16,648
5		$43,320	$43,320	0.906	$39,236
6		$18,020	$18,020	0.888	$16,001
7		$18,020	$18,020	0.871	$15,688
8		$18,020	$18,020	0.853	$15,380
9		$18,020	$18,020	0.837	$15,078
10		$43,320	$43,320	0.820	$35,538
11		$18,020	$18,020	0.804	$14,493
12		$18,020	$18,020	0.788	$14,209
13		$18,020	$18,020	0.773	$13,930
14		$18,020	$18,020	0.758	$13,657
15		$43,320	$43,320	0.743	$32,188
16		$18,020	$18,020	0.728	$13,127
17		$18,020	$18,020	0.714	$12,869
18		$18,020	$18,020	0.700	$12,617
19		$18,020	$18,020	0.686	$12,370
20		$43,320	$43,320	0.673	$29,153
21		$18,020	$18,020	0.660	$11,889
22		$18,020	$18,020	0.647	$11,656
23		$18,020	$18,020	0.634	$11,428
24		$18,020	$18,020	0.622	$11,204
25		$43,320	$43,320	0.610	$26,405
26		$18,020	$18,020	0.598	$10,768
27		$18,020	$18,020	0.586	$10,557
28		$18,020	$18,020	0.574	$10,350
29		$18,020	$18,020	0.563	$10,147
30		$43,320	$43,320	0.552	$23,916
				TOTAL PRESENT WORTH	**$1,527,306**

NAVAL SUPPORT FACILITY - INDIAN HEAD
Indian Head, Maryland
Site 38 - Rum Point Landfill
Alternative 3: Landfill Removal with Land Use Controls
Capital Cost

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare LUC Documents	150	hr			$39.00		$0	$0	$5,850	$0	$5,850
1.2 Prepare Documents & Plans including Permits	300	hr			$39.00		$0	$0	$11,700	$0	$11,700
1.3 Prepare Monitoring Plan	120	hr			$39.00		$0	$0	$4,680	$0	$4,680
1.4 Completion Report	100	hr			$39.00		$0	$0	$3,900	$0	$3,900
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	7	ea			$188.00	$566.00	$0	$0	$1,316	$3,962	$5,278
2.3 Utility Connection/Disconnection (phone/electric)	1	ls	$1,500.00				$1,500	$0	$0	$0	$1,500
3 FIELD SUPPORT											
3.1 Office Trailer	2	mo				$365.00	$0	$0	$0	$730	$730
3.2 Field Office Equipment, Utilities, & Support	2	mo		$508.00			$0	$1,016	$0	$0	$1,016
3.3 Storage Trailer	2	mo				$94.00	$0	$0	$0	$188	$188
3.4 Construction Layout Survey	5	day	$1,150.00				$5,750	$0	$0	$0	$5,750
3.5 Site Superintendent	45	day		$134.00	$480.00		$0	$6,030	$21,600	$0	$27,630
3.6 Site Health & Safety and QA/QC	45	day		$134.00	$360.00		$0	$6,030	$16,200	$0	$22,230
4 DECONTAMINATION											
4.1 Decontamination Services	2	mo		$1,250.00	$2,350.00	$1,550.00	$0	$2,500	$4,700	$3,100	$10,300
4.2 Equipment Decon Pad	1	ls		$5,500.00	$7,200.00	$3,540.00	$0	$5,500	$7,200	$3,540	$16,240
4.3 Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4 Decon Water Storage Tank, 6,000 gallon	2	mo				$813.00	$0	$0	$0	$1,626	$1,626
4.5 Clean Water Storage Tank, 4,000 gallon	2	mo				$731.00	$0	$0	$0	$1,462	$1,462
4.6 Disposal of Decon Waste (liquid & solid)	2	mo	$990.00				$1,980	$0	$0	$0	$1,980
5 SITE PREPARATION											
5.1 Underground Utility Clearance	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
5.2 Tree Chipper	3	day				$710.60	$0	$0	$0	$2,132	$2,132
5.3 Stump Chipper	3	day				$170.70	$0	$0	$0	$512	$512
5.4 Dozer, 200 hp	10	day			$372.40	$1,243.00	$0	$0	$3,724	$12,430	$16,154
5.5 Site Labor, (3 laborers)	30	day			$280.80		$0	$0	$8,424	$0	$8,424
5.6 UXO Technician	10	day		$134.00	$345.00		$0	$1,340	$3,450	$0	$4,790
5.7 Debris Removal & Disposal	40	ton	$56.00				$2,240	$0	$0	$0	$2,240
6 EXCAVATION AND DISPOSAL											
6.1 Excavator	20	day			$372.40	$1,652.00	$0	$0	$7,448	$33,040	$40,488
6.2 Dump Trucks (2)	40	day			$372.40	$1,271.00	$0	$0	$14,896	$50,840	$65,736
6.3 Loader (2)	40	day			$372.40	$960.00	$0	$0	$14,896	$38,400	$53,296
6.4 Dozer, 200 hp	20	day			$372.40	$1,243.00	$0	$0	$7,448	$24,860	$32,308
6.5 Screening Plant	20	day			$372.40	$614.10	$0	$0	$7,448	$12,282	$19,730
6.6 Site Labor, (3 laborers)	60	day			$280.80		$0	$0	$16,848	$0	$16,848
6.7 UXO Technician (2)	40	day		$134.00	$345.00		$0	$5,360	$13,800	$0	$19,160
6.8 Transportation and Disposal, Subtitle D	6,150	ton	$75.00				$461,250	$0	$0	$0	$461,250
7 SITE RESTORATION											
7.1 Topsoil, 6" thick	810	cy		$27.33			$0	$22,137	$0	$0	$22,137
7.2 Seed Cover	45	msf	$96.50				$4,343	$0	$0	$0	$4,343
7.3 Dozer, 200 hp	5	day			$372.40	$1,243.00	$0	$0	$1,862	$6,215	$8,077
7.4 Site Labor, (3 laborers)	15	day			$280.80		$0	$0	$4,212	$0	$4,212
Subtotal							$484,563	$51,313	$181,602	$198,819	$916,297

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Overhead on Labor Cost @ 30%									$54,481		$54,481
G & A on Sub, Material, Labor, & Equipment Cost @ 10%							$48,456	$5,131	$18,160	$19,882	$91,630
Tax on Materials and Equipment Cost @ 6%								$3,079		$11,929	$15,008
Total Direct Cost							$533,019	$59,523	$254,243	$230,630	$1,077,415
Indirects on Total Direct Cost @ 20%	(excluding transportation and disposal cost)										$122,837
Profit on Total Direct Cost @ 10%											$107,741
Subtotal											$1,307,993
Health & Safety Monitoring @ 2%											$26,160
Total Field Cost											$1,334,153
Contingency on Total Field Costs @ 20%											$266,831
Engineering on Total Field Cost @ 5%											$66,708
TOTAL CAPITAL COST											**$1,667,692**

NAVAL SUPPORT FACILITY - INDIAN HEAD
Indian Head, Maryland
Site 38 - Rum Point Landfill
Alternative 3: Landfill Removal with Land Use Controls
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Site Inspection	$6,586		Labor and supplies to visit site once a year to inspect Land Use Controls with Report
Monitoring Sampling	$7,500		Labor and supplies to collect samples from 4 wells, annually years 1-30.
Monitoring Sampling Analysis/Water	$1,680		Analyze groundwater samples for SVOCs, and inorganics including QA/QC cost.
Site Review		$23,000	Five-Year Site Reviews
SUBTOTAL	$15,766	$23,000	
Contingency @ 10%	$1,577	$2,300	
TOTAL	**$17,343**	**$25,300**	

NAVAL SUPPORT FACILITY - INDIAN HEAD
Indian Head, Maryland
Site 38 - Rum Point Landfill
Alternative 3: Landfill Removal with Land Use Controls
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,667,692		$1,667,692	1.000	$1,667,692
1		$17,343	$17,343	0.980	$17,003
2		$17,343	$17,343	0.961	$16,669
3		$17,343	$17,343	0.942	$16,342
4		$17,343	$17,343	0.924	$16,022
5		$42,643	$42,643	0.906	$38,623
6		$17,343	$17,343	0.888	$15,400
7		$17,343	$17,343	0.871	$15,098
8		$17,343	$17,343	0.853	$14,802
9		$17,343	$17,343	0.837	$14,512
10		$42,643	$42,643	0.820	$34,982
11		$17,343	$17,343	0.804	$13,948
12		$17,343	$17,343	0.788	$13,675
13		$17,343	$17,343	0.773	$13,406
14		$17,343	$17,343	0.758	$13,144
15		$42,643	$42,643	0.743	$31,684
				TOTAL PRESENT WORTH	**$1,952,999**

CLIENT: NAVAL SUPPORT FACILITY, INDIAN HEAD				JOB NUMBER: 112G02050.0000.1120	
SUBJECT: Site 38 - Rum Point Landfill					
BASED ON:				DRAWING NUMBER:	
BY:	TJR	CHECKED BY:	SMV	APPROVED BY:	DATE:
Date:	6-28-12	Date:	7-12-12		

Landfill Area & Volume

37,500 sf of landfill
4,100 cy landfill volume

Alternative 1: Capping and Land Use Controls

Capital Cost

Site Preparation

Clear & grub area, chip stumps, spread under cap: 37,500 sf
Regrade landfill with UXO Technician posted
Remove debris & surface landfill materials, disposal offsite: assume 40 tons
Proof-roll landfill

Landfill Cap

Geotextile, 8 oz.	37,500	sf
Gas management layer (6" thick) is the top of the interim grade:		
	37,500	sf
	0.5	ft
	18,750	cf or
	694	cy
Geotextile, 12 oz.	37,500	sf
Liner, 40 mil	37,500	sf
Geotextile, 12 oz.	37,500	sf
Drainage Layer, 12" thick	37,500	sf
	1	ft
	37,500	cf or
	1,389	cy
Common Fill, 18" thick	37,500	sf
	1.5	ft
	56,250	cf or
	2,083	cy
Topsoil, 6" thick	37,500	sf
	0.5	ft
	18,750	cf or
	694	cy
Seed, area + 15%	43	msf

CLIENT: NAVAL SUPPORT FACILITY, INDIAN HEAD			JOB NUMBER: 112G02050.0000.1120	
SUBJECT: Site 38 - Rum Point Landfill				
BASED ON:			DRAWING NUMBER:	
BY: TJR	CHECKED BY:	SMV	APPROVED BY:	DATE:
Date: 6-28-12	Date:	7-12-12		

Time to Complete

	days	
Mobilization	5	
Site prep	5	
Earthwork	20	
Liner/Geotextile Placement	5	
Demob	5	
	40	days
	2	months

Annual Cost

LUC Inspection/Report: Annually

Assume out of town travel to site for two days/two people.

Air	$1,400	
Car	$200	
Per Diem	$536	
Hours	$4,200	(60 hours * $70/hr)
Misc	$250	
	$6,586	

Monitoring Sampling (once a year)

Labor & Materials, per round (4 wells)

Assume 2 days to sample with 2 people, local plus 1 day of preparations

2 people @ $70.00 per hour for 10 hours per for 3 days =	$4,200
car for 3 days =	$300
report @ $75.00 per hour for 30 hours =	$2,250
IDW disposal =	$350
Misc supplies, copying, etc. =	$400
	$7,500

Analytical, per round for 30 years

Collect 4 samples and analyze for VOCs, SVOCs, & inorganics

type	cost each	number	total
VOCs	$110	4	$440
SVOCs	$150	4	$600
inorganics	$150	4	$600
			$1,640
40% QA/QC & Data Validation			$656
			$2,296

Five Year Review Cost

Assume $23,000

CLIENT: NAVAL SUPPORT FACILITY, INDIAN HEAD		JOB NUMBER: 112G02050.0000.1120
SUBJECT: Site 38 - Rum Point Landfill		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 6-28-12	CHECKED BY: SMV Date: 7-12-12	APPROVED BY: DATE:

Alternative 2: Landfill Removal and Land Use Controls

Capital Cost

Assumptions

UXO Technician posted at excavation area and at dewatering/screening area.
Excavation and disposal rate of 440 tons per day.
Water collected during excavation and dewatering activities to be returned to excavation after filtering.
Regrade remaining soil to provide positive drainage
Cover excavated area with 6 inches of topsoil.

Site Preparation

Clear area of trees & bushes, use chipped material for temporary roads.
Remove debris & disposal offsite: assume 40 tons
Construct screening area

Excavations & Disposal

Load soil onto trucks and haul to dewatering/screening pad (150' by 25').
Spread for visual screening and dry if necessary.
Once dry, mechanically screen material.
Dispose of material offsite in subtitle D landfill as non-hazardous.
All explosive materials to be removed by the Navy at no cost to the contractor.

Volume of material to be excavated:	4,100	cy
disposal at 1.5 tons per cy	6,150	tons
haul & dispose at 440 tons per day	14	days
additional time for screening excavated soil	6	days

Site Restoration

Cover area (1 acre) with 810 cy of topsoil
Seed area 45 msf

Time to Complete	days	
Mobilization	5	
Site prep	10	
Excavation/Screening/Disposal	20	
Site Restoration	5	
Demob	5	
	45	days
	2	months

CLIENT: NAVAL SUPPORT FACILITY, INDIAN HEAD		JOB NUMBER: 112G02050.0000.1120	
SUBJECT: Site 38 - Rum Point Landfill			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 6-28-12	CHECKED BY: SMV Date: 7-12-12	APPROVED BY:	DATE:

Annual Cost

LUC Inspection/Report: Annually

Assume out of town travel to site for two days/two people.

Air	$1,400	
Car	$200	
Per Diem	$536	
Hours	$4,200	(60 hours * $70/hr)
Misc	$250	
	$6,586	

Monitoring Sampling (once a year)

Labor & Materials, per round (4 wells)

Assume 2 days to sample with 2 people, local plus 1 day of preparations

2 people @ $70.00 per hour for 10 hours per for 3 days =	$4,200
car for 3 days =	$300
report @ $75.00 per hour for 30 hours =	$2,250
IDW disposal =	$350
Misc supplies, copying, etc. =	$400
	$7,500

Analytical, per round for 15 years

Collect 4 samples and analyze for SVOCs & inorganics

type	cost each	number	total
SVOCs	$150	4	$600
inorganics	$150	4	$600
			$1,200
40% QA/QC & Data Validation			$480
			$1,680

Five Year Review Cost

Assume $23,000